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Factory Methods For the Small Manufacturing Plant

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The control of stores and routing—Production and cost systems—Determining the amount of premium allowance—Recording the sequence of operations

IT IS a common assumption that the production- and cost-keeping system that will work in the large organization will not work in the small plant. The system described has long been in successful operation in a plant employing about 150 men. In this system bin tickets, routing tags and time tickets are used to keep track of the stores and supplies used. The production and cost systems and the method for determining the premium rate are reduced to a simple and workable basis

THERE are a great many executives connected with the smaller manufacturing plants, employing somewhere between 25 and 200 people, who feel that the various systems pertaining to wage payment and manufacturing processes in use today are all right for the large plant, but out of place in their particular shop. This assumption is usually based on the erroneous theory that any system that works satisfactorily in the larger plant entails entirely too much "overhead" for their own shop.

To the detriment of many of the smaller shops the matter is too frequently dropped and denied further consideration. It is not the purpose of the author to speak for any particular system of those now in successful operation in many plants, but rather to describe in detail a system developed in a manufacturing plant employing approximately 150 people.

The product of this plant is so varying in size that the quantities are of necessity small. A lot of fifty pieces of the smaller items that are interchangeable on the various units is rather uncommon and lots of from four to ten pieces are about the average amount. Consequently all equipment has to be adapted through suitable jigs and fixtures to cover a great variety of sizes and shapes. The organization of this plant has developed over a period of years the methods described and in addition has devoted time to the study of the scheduling and routing of stores, and control, premium and cost systems.

The ordering and control of material so as to guard against overstocking of certain items is always quite a problem in any plant, and it easily becomes a menace in a small plant manufacturing a great variety of products. Most executives remember the sad experience of a few years ago when surplus inventories had to be materially depreciated and they consequently realized how important an item surplus material in stores becomes, aside from the fact that much capital is uselessly tied up.

With the idea in mind of eliminating the expense involved in maintaining a perpetual inventory system of raw material in stock the simple bin ticket illustrated in Fig. 1 was devised. Whenever an order is issued by the sales department to build a certain number of units, routing tags as shown in Fig. 2 are issued by the cost department together with clock or time tickets, a sample of which is shown in Fig. 3. The route tags give the symbols, drawing numbers, quantity, as well as the order number and the sequence of operations through the various departments. The quantities, symbols and drawing numbers are taken from the production sheets, while the sequence of the operations is obtained from the master route sheets.

These route tags are taken by the stores department and checked with the bin tickets. The number of pieces available to be applied on this order are marked on the route tag, and an entry is made on the bin ticket stating the order number, and number of surplus pieces, if any, that can be used for future orders. In case enough pieces are not available to fill the order, the stores department issues a requisition to the order department for the amount needed. A sufficient surplus is ordered so as to carry in stock the required amount stated on the bin ticket for future requirements.

On all items except large castings ordered through the factory a surplus amount varying from two to ten per cent is specified covering rejections for any cause and repair department requirements.

Systematic arrangement of storage bins to correspond with production sheets is, of course, most desirable since it results in a considerable saving of time.

The routing scheme is of necessity closely associated with stores control. The master route cards, as made up from the operation sheets, give only the sequence of the operations and the departments in which they are performed. The route cards, as has been noted, are

RAW STOCK TAG.

Section C Symbol M17

Bin No. 400 Name of Part Pinion

Orders Issued			Disbursements			Receipts		Inventory		Balance
Date	S. O.	Amt.	Date	S. O.	Amt.	Date	Amt.	Date	Amt.	
3/4	1911	42	Cancelled					3/10	180	
3/4	1912	42	Cancelled							
3/23	5824	25	3/23	5824	25					95
11/7	5009	15	11/7	5009	15					80
1/4	4886	25	1/17	4886	25					55

Fig. 1—A simple bin ticket

taken care of by the cost department at the time the orders for the various parts are issued. All route tags for which the material is available are sent from the stores department to the production department. Those tags for which material is not available, and has to be ordered, are kept in pockets in the stores department until such time as the material is received. As soon as the material is received the tags are sent to the production department.

Production System

When the first tags are received by the production department a notation is made on the production board and the status of the material is indicated on this board by means of a colored pin. The production board in use was devised largely to show at a glance the condition of the order. The various assemblies are placed on the left-hand side on the board. At the top of the board are four headings designating material not as yet available, material available in rough stores, material in process in factory and material in finished stores. Pins of different color are used to designate the various conditions mentioned and while this method is open to criticism in so far as it does not give the location of the material in any specific department nor state its condition in that department we have found it to work exceedingly well, as the production clerk whose duty it is to post the work on the various departmental production boards can usually tell off hand the exact condition of the material as well as its exact location in the shop. As the date at which the order should be available for the erecting floor is shown on the production board the process of the order can be observed readily. It is found that one man by this method can guide the production of a machine shop, handling a large variety of work and employing approximately 80 people.

As no cost system can function unless accurate data are available it is, of course, quite important that every minute of the time spent in the factory by any employee is accounted for. It is equally important that accurate data regarding material are available. When any material is delivered from the storeroom it is, as has been previously mentioned, accompanied by a route tag. The stub end of this tag shows the kind and weight of material as well as the order number, and this is detached as soon as the department foreman receiving the material has affixed his signature. It is then sent to the cost department where an entry is made on the cost card. As each operation is finished, the job ticket shown in Fig. 3 is also sent to the cost department, and the time for each operation together with wages paid is posted on the cost card. In case any operation is materially higher than the previous average a reminder stating previous average and present time is sent to the superintendent's office for his consideration. At the end of the pay period all the job tickets of every employee are checked against the clock tickets on the in and out recorder. All job tickets, therefore, on which work has been performed during the pay period, are sent to the cost department and a duplicate ticket is made out on which the operation can be continued in the next pay period.

In order to facilitate the planning of work ahead for the various operators a board is provided in each

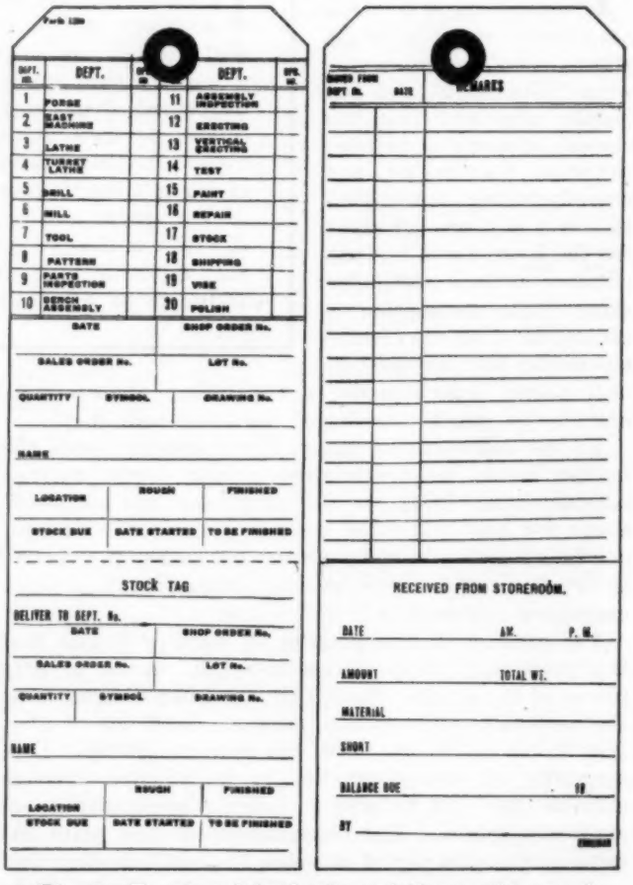


Fig. 2—Front and back view of the routing card

department. This board is of sufficient size to permit of having three pockets for each operator marked respectively, jobs working, jobs waiting and jobs suspended. This scheme lets the operator know what his next job is to be, and it also allows the trucker to obtain the necessary tools and fixtures on time.

In order to be able to tell definitely just what amount

of time is spent in each department on defective castings or how much time and material is lost by bad workmanship or what supplies have been used, a series of standing shop orders are issued to allow the charging of such items. This enables the superintendent

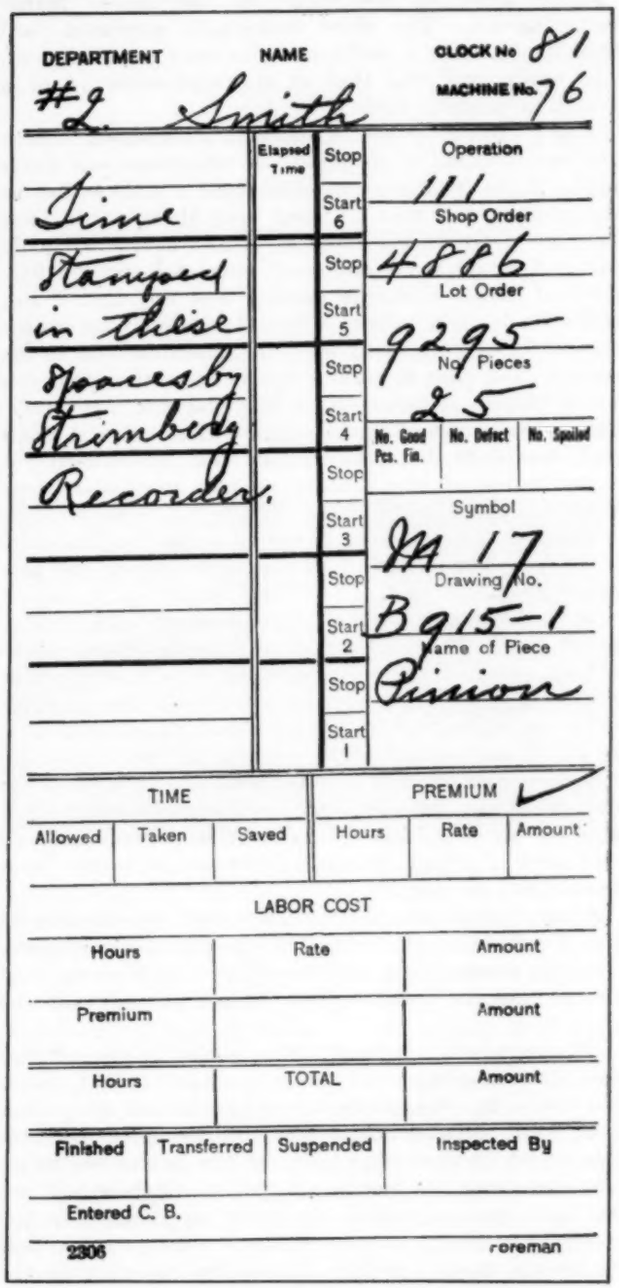


Fig. 3—The clock or time card

at the end of each month to know definitely how much time was spent in each department salvaging defective material or bad workmanship, as well as to know the amount of supplies used, the amount of small tools broken and the total up-keep of machinery, jigs and fixtures. Most executives realize the importance of accurate information and it is quite surprising how the department heads watch the non-productive accounts when they know that the monthly report will show up any irregularity.

These reports are taken up with each department head at the end of each month and the department foreman is thus enabled to watch expense items from time to time.

No premium system should be installed without proper analysis of operating conditions. It is often quite surprising what savings can be accomplished by the proper study of operating conditions, arrangement of tools, and fixtures, and the classification of equipment. A suitable bench on which a tool tray can be arranged is often very beneficial to the operator since it often avoids many unnecessary movements. It is the writer's conviction that no attempt at rate setting should be made until the conditions mentioned together with the scheduling and routing have been taken care of.

In installing any premium system many grievances can be avoided and many petty obstacles overcome by the choice of a competent time-study man or rate setter. This man should be thoroughly acquainted with the system to be installed. He should know machine tools and their performance thoroughly and he should be able to demonstrate at any time that the times set are reasonable and readily attained and maintained by the operator, and he should also be thoroughly acquainted with the performance of the finished product. It is remarkable how quickly a good, live wire can be trained from the organization to perform this time-study work satisfactorily.

Assuring a Flexible System

In order to build up a flexible unit it was decided to classify all the machinery, placing the machines on which certain operations can be performed equally well in the same class. This enables the department foreman to shift an operation from one machine to another without affecting the performance and it also gives the time-study man the opportunity to set a standard time on different machines with different operators, thus more nearly approaching regular operating performance. All time-study operations are carefully noted and the records are filed.

An operation sheet is compiled showing the sequence of the operations to be performed on any part as well as a complete description of each operation. A copy of the sheet is kept in each department. Every operation is numbered. If milling is considered as operation ten then the first milling operation becomes 101, the second operation on the same part becomes operation 102 and so on.

Our premium system is of the participating form and includes firm, operators, foremen and truckers, each sharing as follows in the total premium earned:

Firm	40%
Operator	40%
Foremen	7%
Trucker	3%
Contingent Fund	10%

The contingent fund is used to penalize any overruns of time allowed on a percentage basis and the remainder is divided once every month between all the departments, employees all sharing alike. No time is allowed for any pieces that are spoiled in machining, but time is allowed for work performed on castings that show up a defect during the machining operation. This time allowance is always made by the time-study man and is based on the percentage to which the operation was performed when the defect manifested itself. This time, instead of being charged against the order

on which the pieces are being machined, is charged against a defective-material order covering the source from which material was obtained.

A standard set-up time is allowed for setting up the machine, and a separate time study is made of this operation in each case. The necessary drawings and tools are delivered from the tool crib by the trucker before the operator is assigned to the operation.

In order to handle tools and fixtures in this manner it is, of course, necessary that all tools be numbered and indexed. Tools and fixtures were therefore systematically arranged, and a definite location, as well as a number assigned to each tool or fixture. A card showing the location, tool number date at which tool was completed as well as its shop order number on which it was built is kept in the tool crib. These cards are alphabetically arranged in a cabinet under the part number, and a master record card is kept in the production office.

In order that the foreman may be at all times able to refer to any particular operation each department is provided with a loose leaf volume of operation sheets. On these sheets each operation is numbered and briefly described and the machine on which the operation is performed is also shown as well as the set-up and standard time. The tool number of main tools and fixtures to be used is also given. On parts requiring a number of standard and special tools and fixtures a record is kept in the tool crib filed under the part number. This card gives all the tools in the order in which they are to be used.

This system was followed at one of the plants with which the author has been connected. While it has largely been built up and added to as the need was manifested during the last few years, it has nevertheless worked very satisfactorily. The great amount of clerical cost and overhead that so often condemns a system of operation for the smaller shops, has been largely avoided, and under the operation of the system the manufacturing costs have shown a material reduction.

To Reduce Splitting on a Pressed-Steel Draw

When steel has to be drawn into irregular shapes that include points where the stretch is severe and near an edge there will be trouble encountered with splitting. Examination shows that these cracks will start at the outside edge and run inward, which is only natural.

Closer examination indicates that usually the crack will start at a point where two die-steels joined in the blanking die leaving a serration across the blank or where there was a nick in the punch or die.

In one company where the trouble had occurred on a drawing operation on automobile side-rails the per cent of rejection was materially reduced by setting up a grinder on a vertical axis and by then running the blank edge at the point of draw longitudinally against the wheel while the blank was kept flat, or, in other words, at right angles to the direction of the draw.

This removed the cross scratches, changing the markings on the edge to ones that ran lengthwise rather than across the edge. Apparently the point was gained by eliminating all markings and scratches that could act by their direction and location to start a split in the steel as it was stretched over the point of difficult draw.

Bonds or Tools?

By W. F. Sandmann

TWO cards lay on the desk before the president and principal stockholder of the A—— Manufacturing Co. The more imposingly engraved card bore the name of a well-known security establishment. The other card was that of the representative of a dealer in machine tools.

The president turned to his factory manager. "Here are two methods of spending—or investing—our earnings. If the bond salesman had come a little earlier or the machine-tool man an hour later there would have been no doubt in my mind as to the course I should take. I would have purchased some well-secured five-per-cent bonds with our surplus and felt that I had taken the proper course. But this other card raises the doubt. Do we really need new machine tools in the plant? You have remarked from time to time that you would like to replace this or that machine, but everything always appears to be running along in good shape and therefore I have doubted the advisability of expenditures of that nature at this particular time. What are the facts?"

The manager smiled as he produced his memorandum book from his pocket. "I have been waiting for this opportunity," he said. "The conclusions I have reached after a thorough survey of our equipment, I have noted in this book. Our oldest piece of machinery is not over fifteen years of age. There is hardly a machine that has been in operation eight years or more that couldn't be profitably replaced with up-to-date equipment. For two thousand dollars or so we can buy a new milling machine that will cut between two and three hours a day off of our present time on the frame job. After allowing the usual ten-per-cent annual depreciation, we can show a return on the investment of better than twenty-five per cent."

"But it will take several years for the machine to pay for itself at that rate," the president interrupted. "It has always been my theory that a machine tool should pay for itself in less than two years at the most."

"Your theory is wrong," the manager replied. "Any first-class machine tool has ten years of ordinary service life in it. We should figure ours at not more than six years, because they may be obsoleted by new machinery at that time. But at the end of six years you can scrap the machine as junk—which it will not be—and have realized a return of approximately ten per cent annually on your money. Your principal will be in the bank and if you keep the machine in the plant, you have a tool that is fifteen years younger, more accurate and more nearly modern than the present milling machine. It appears to me that investments in millers, drills, turret machinery, etc., will pay you far better dividends than the five-per-cent bonds you have in mind."

The president made a few figures on the pad in front of him. Then he went to the door of the reception room and talked a few moments with the representative of the security establishment. "Not interested," was the gist of the brief conversation. As the door closed behind the bond man the president motioned to the machine-tool salesman. "Come in and bring your books. We are beginning a house cleaning around here right now, and we want to talk machinery."

Typical Turret Tooling

By Fred H. Colvin
Editor, *American Machinist*

The use of standard tools and set-ups on semi-automatic chucking machines of the Potter & Johnston type equipped with pilot bars and cross slide tools

THE proper set-up of all types of machine tools is a subject that has been receiving constantly increasing attention from production men during the last ten years. While the early design of machines and tools was quite adequate to assure maximum production at any speeds and feeds that available cutting materials would stand, with the development of high

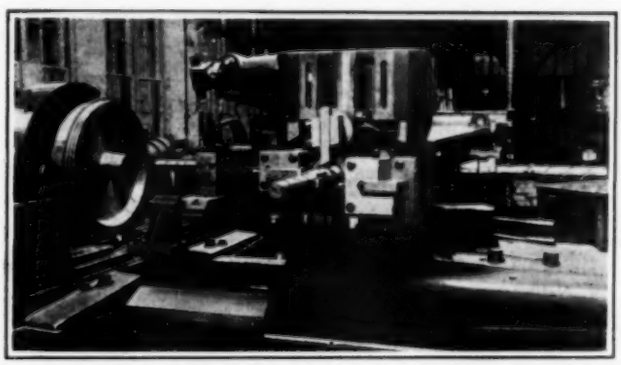


Fig. 1—Turning a special pulley

speed steel came the necessity for more rugged machine construction, as exemplified by modern machine tools of various kinds. The possibilities of cutting metal with modern tools make it particularly desirable to give much thought and attention to the proper mounting and support of all cutters. The nearer we can come to eliminating vibration from the cutting edges and to the prompt dissipation of heat, the less time will be needed for regrinding of tools. This factor is of major importance in obtaining maximum output from any machine, and particularly so in the case of automatic chucking machines, where a considerable number of cutting tools are mounted for simultaneous operation.

Automatic chucking machines are now in operation in many shops, turning out comparatively small lots of similar pieces with frequent change overs, and showing a substantial saving in production cost over that formerly obtained from the use of hand machines.

Under these conditions, in order to keep the investment in special cutting tools, holding devices, etc., at a minimum, and set-up time moderately low, it is necessary to use as many standard tools as possible, supplementing them with specials where absolutely necessary.

When such machines are set up in regular production, where they are infrequently changed over, a considerable investment in special tooling equipment will invariably show a saving in production cost that will justify the additional expenditure. There are also some instances in which the use of a fairly extensive outfit of special tools will show justification whenever small lots of work are being put through the shop. A small amount of extra attention to details in set-ups of this kind will, in many instances, eliminate a subsequent operation and substantially reduce production cost.

It is desirable to pilot all cuts as far as possible, especially when multiple cutting tools are operating simultaneously. The form of pilot to be used will vary with the cutting conditions, which should receive careful study by the tool designer.

A simple design of pilot is illustrated in Fig. 1. This pilot is incorporated in the boring bar carried in the turret, and is supported in the chuck or spindle nose. It is case-hardened and ground, entering a bushing of the same material. The type of oil grooving, shown in detail in Fig. 2, has been found to be particularly effective. The direct method of supporting the cutting blades may be successfully employed in fair-sized holes, with the bars made from SAE-1020 steel, case hardened. It is always desirable to maintain maximum rigidity, and when it is necessary to use a boring bar of a small diameter at the pilot end, it will be well to make the bar from alloy steel, such as SAE-3140.

For use when the hole in the work is so small that even alloy-steel pilots lack sufficient rigidity, or in case

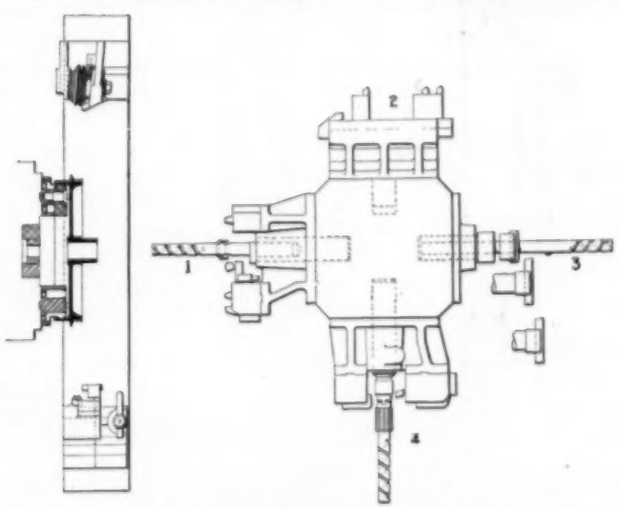


Fig. 2—Details of tooling for pulley

the hole to be bored is blind, precluding the employment of any spindle center-line piloting, the tool guide is advantageous. The tongue mounted on the turret face, as well as the guide plate and straps attached to the base of the cross-slide, are made of tool steel, hardened and ground. This construction will show very little wear over a long period of use. Overhead pilots are

also found effective under some conditions. In order to secure alignment of the bars with the support bushing, it is advisable to make either the bars or the bushings with a double eccentric mounting.

A change has taken place in methods of tooling chucking machines, in the more extensive employment of single point cutters, rather than forming cutters, for the removal of scale from castings or forgings. It is, of course, still occasionally necessary to take broad cuts, but in tooling a piece of work the use of slide tools should receive first consideration, since tool upkeep will be lessened and time lost in grinding tools will be greatly reduced.

In cases where a long facing cut is to be taken, the roughing time can be considerably reduced if one or two "spading" tools enter the scale on the preceding turret face, as shown in Fig. 2. Because of the peculiar form of these cutting tools, which quickly get under the scale, they have a long life and do not ordinarily require excessive regrinding. This set-up makes the necessary travel of the slide-tool comparatively short, resulting in a marked production increase.

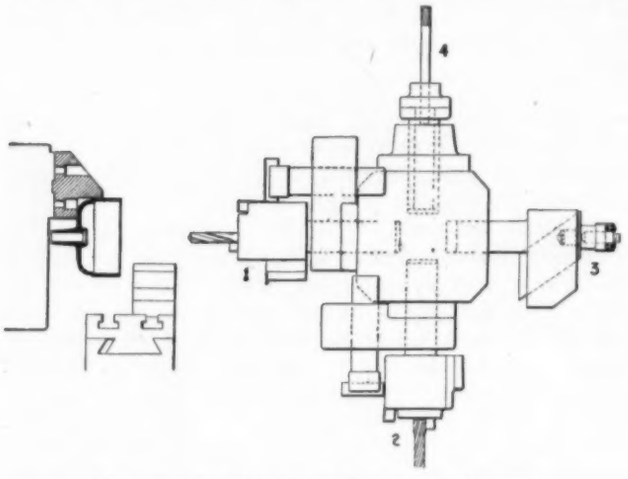


Fig. 3—Machining a fan motor frame

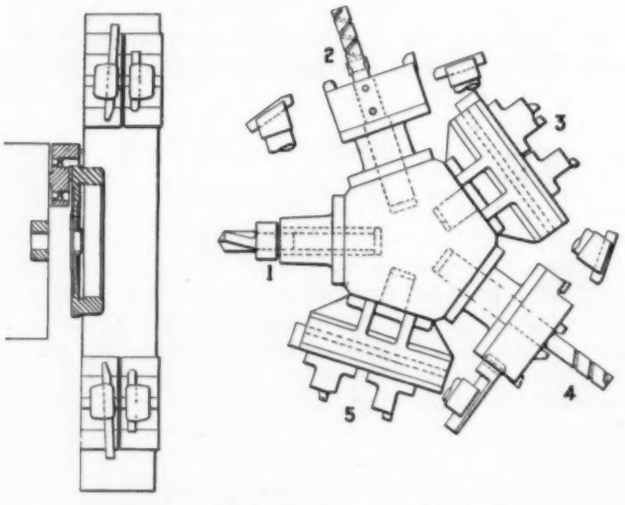


Fig. 4—Tools for a motor flywheel

Practical application of the principles expressed regarding development in the design of special tools, can be seen in the three set-ups shown in detail in Figs. 2, 3 and 4, in which many of the constructional features previously mentioned are combined. The line cuts illustrate the distribution of tooling as applied to the four turret faces. The following condensed outline will assist in interpreting the layouts.

The work shown in Figs. 1 and 2 is a card tape drive pulley of cast iron, for use on textile machinery. It is held with three swivel-type jaws. The operations are:

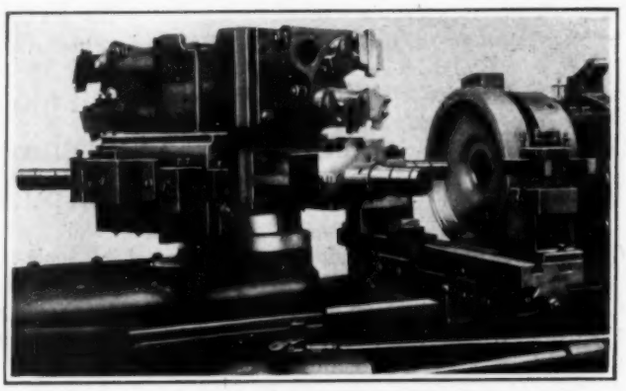


Fig. 5—How the flywheel is machined

1st turret place:
- Rough-bore center hole.
- Rough-turn center hub (two diameters).
- Rough-form under rim.
- Spade for start of slide tool on next turret face.
- Rough-face center hub.
- Rough-turn periphery up to flange.

2nd turret face:
- Rough-face web (slide tool operated by front cross slide).
- Rough groove.
- Rough-face edge of pulley with front cross-slide.

3rd turret face:
- Finish-bore hole.
- Finish-face center hub.
- Finish-turn center hub.
- Finish-turn periphery with outer tool.
- Finish groove. } Rear cross-slide
- Finish-face edge of pulley. }

4th turret face:
- Ream center hole.
- Reamer followed by tool for sizing center hub and blades for removing tool marks from web.

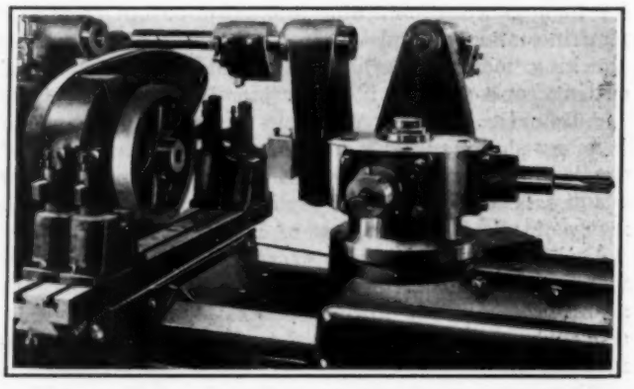


Fig. 6—A flywheel job—using overhead pilots

The small, cast-iron electric fan-motor frame in Fig. 3 is held with three jaws under regulated pressure. The operations are:

1st turret face:
- Rough-drill hole.

Rough-face center hub.
Rough-bore large diameter.
Rough-face rim.
2nd turret face:
Finish-bore hole. } Step drill.
Finish counterbore. }
Finish-face center hub.
Finish-bore large diameter.
Finish rim.
3rd turret face:
Recess counterbore.
4th turret face:
Ream—Automatic change of feed used.

In Fig. 4 is an automobile flywheel, drop forged from 0.40 carbon steel. It is held on the periphery in a three-jawed chuck. The operations are:

1st turret face:
Rough-drill center hole.
2nd turret face:
Rough-bore center hole.
Rough-bore large diameter.
Rough-turn periphery.
Rough-spade web to start slide tool.
3rd turret face:
Rough-turn center hub.
Rough-face web and recess (turret-slide tool operated by front cross slide).
Rough-face edge of wheel.
4th turret face:
Finish-turn center hub.
Chamfer center hub.
Finish-bore large diameter.
Finish counterbore.
Chamfer.
5th turret face:
Finish-face web (two surfaces), (turret slide tool operated by rear cross slide).
Finish-face edge of wheel.
Automatic changes of speed used.
Automatic changes of feed used.

Another method of piloting is shown in Fig. 6 where an outside turning tool is supported by the overhead pilot bar shown.

While some of the suggestions made may appear to involve considerable extra expense, actual experience with their use will convince the most skeptical production manager that the direct and indirect savings resulting will amply justify the extra expenditure.

Locating Trouble in an Air Compressor

BY EDWARD WILLIAMS

One of three air compressors that were all needed on the line was not delivering to capacity. The engineer was unable to spot the trouble without losing time so he put in a call for the manufacturer's service man.

The service man arrived, looked over the machine, put his hand on the different valve bonnets and stated that in ten minutes he could correct the trouble unless something very unusual was wrong.

The engineer stopped the machine. Together they removed the valve bonnet over one of the intake valves, found a broken valve, substituted a new one, replaced the bonnet and put the machine back on the line.

The bonnet over the broken intake valve had been quite hot when it should have been cold and indicated a back rush of hot air through the port.

Seen and Heard

BY JOHN R. GODFREY

Shapes of Cutting Tools

THE Klopstock form of cutting tool as recently shown at the A.S.M.E. meeting in Milwaukee, is interesting in several ways, one of which is to show how easily we forget ideas that are proposed from time to time. There was the De Leeuw cutting tool of several years ago that was designed on the same plan and that worked well on all tests. Then there was the circular tool that rolled into the work and with which enormous cutting speeds were secured, probably because the cutting edge cools by rolling out of the work quickly. But we have never utilized either in practice.

Ever since the days when Fred Taylor told us that the old diamond point was a back number and that the only tool that ought to be used for roughing was the round-nosed hogging tool, we've seemed to accept it, whether we believed it or not. Perhaps it was because we were not used to statistics and tests that we swallowed his tool shapes as the last word in cutting.

But some of us old timers remember that when we had to take a heavy cut in order to get under the scale of a casting, and only a light lathe to do it on, we didn't use either a round-nose or a diamond-point tool. We took a side facing tool, such as we used to face the ends of a bar, and rounded the end to a small radius just to take off the sharp corner. These tools had a very heavy top rake so that they actually *cut* instead of tearing the metal off. With these tools we used to take a heavy cut with little power. It didn't take a dynamometer to prove that the tools were cutting easily. If the narrow belt on the lathe pulled the cut, it was all the test we needed.

Our good friend Hartness also used tools of this kind in the early flat turrets and the chips curled off the bar very easily. This in fact was one of the reasons that the diamond point tool held favor so long. With a combination of top rake and side cutting angles, the metal was cut with a clean, curling chip instead of with the broken, saw-tooth chip when the tool with little top or side rake is used.

There is another point about cutting tools that some seem to overlook. Vibration is deadly whether it comes from too much overhang or from the tool not being properly supported. With overhang we have the tool springing away from the work, plus the vibration, neither of which is good for the work or the tool. With vibration of the cutting edge, the tool crumbles much more easily and time is lost in regrinding.

In the old days of belt drives, and narrow belts at that, we could measure the power required by any tool with fair accuracy. Furthermore, the belt was a mighty good safety valve when we overloaded a machine. It saved a lot of breaks in gear teeth, as the gears were all cast iron instead of alloy steel.

There are a few machine tool builders who still cling to the belt drive somewhere in the power hook-up, because of its safety valve properties. One builder of a heavy duty drilling machine told me, only the other day, that he always used a fair length of belting between the motor and the spindle as a sort of a "cushion," as well as a safety valve. It's the old "shearing pin" idea, using a belt to slip instead of a pin to shear when an overload comes.

Book Reviews

Elementary Mechanical Drawing. By Chas. Wm. Weick, late assistant professor of drawing and design, Columbia University. Second edition revised by Frank C. Panuska, lecturer in drawing and design, Columbia University. Two hundred and fifty pages, 6x9 in., illustrated. Cloth board covers. Published by McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City. Price $2.

In revising this book, Mr. Panuska has not disturbed the original scope nor the purpose of the author but he has rewritten the chapter on projections and divided it into two parts to cover the rudiments and the theory of the subject.

The book opens with two chapters on instruments and materials of drawing and then develops in a concise and orderly fashion the methods of lettering, dimensioning and general drawing room conventions including sectioning and shading. Chapters VI and VII deal with projection and sketching.

A series of plates and related problems begins with Chapter VIII. There are 38 plates with three problems to each plate, which are graduated from simple objects to more difficult layouts. Geometric problems are fully discussed in the following chapter and here are included all the important constructions that are likely to confront the draftsman.

A very useful chapter on mensuration is included in the work and its character is such that this section of formulas will be found a useful one by anyone working with geometric surfaces and sections. The closing chapter in the book deals with the methods of reproducing drawings and the composition of the materials used in the blueprinting processes.

Principles of Industrial Organization. By Prof. Dexter S. Kimball. 436 pages, 6x9 in. Published by the McGraw-Hill Book Co., New York City. Price $4.

This is the third edition, showing the interest in the subject and in the previous editions. It has been thoroughly rewritten and rearranged in many particulars. The author points out the principles underlying industrial organization, which are too often not clearly understood by shop managers. The new edition gives special attention to the methods and mechanisms of management that have been devised to control production. The economics of production are also discussed freely and frankly, and the discussion shows clearly the scientific background of production in a way that can hardly be misunderstood.

As an example the author points out how the automatic machine reduces the value of the craftsman's skill and so forces him into some other branch of an industry. And that, while this transference of skill ultimately benefits the community, the worker who is displaced is injured unless he immediately finds a new job. It is for this reason that many workers from the days of Hargreave, have been hostile to new machines. Managers know that machinery must continue to develop but it is well for them to consider the effect on the men in the shop and help make the transition as harmless as possible to the worker.

There are 24 chapters, all of them full of ideas for the management of any industry. They deal with production control, time and motion study, compensation, purchasing and keeping stores, standardization, inspection, cost finding, personnel, employee's service and industrial democracy. It is a book to be read by every manager who does not wish to drop behind in the progress of modern industry.

A Graphic Table Combining Logarithms and Anti-Logarithms. By Adrien LaCroix and Charles L. Ragot. Sixty-four pages, 6¾x9¾ in. Published by the Macmillan Co., 60 Fifth Ave., New York, N. Y. Price $1.40.

The book contains a graphic table on which can be read directly without interpolation the logarithms to five places of all five-place numbers and the numbers to five places corresponding to all five-place logarithms.

In addition there is a corresponding table which performs the same functions to four places.

The book is a revelation in accuracy and simplicity especially to those who use logarithms and have had to go over and again through the tedious and accumulatively inaccurate process of interpolation with the usual numerical tables.

Its simplicity is remarkable, five minutes study of the short explanation being ample to master the procedure. It is convenient to use, the numbers being much easier to locate on the plain scales than they are when listed in columns on a table. It is compact, the entire five-place table being contained on forty pages, with the four-place table taking only six pages. Five pages are given over to explanation of the procedure.

By employing the same method as in using a slide rule, calculation to an additional place beyond the five and four direct-reading places on the respective tables is entirely feasible and practical.

Aircraft Year Book—1925. Three hundred sixteen pages, 6x9 in. Published by the Aeronautical Chamber of Commerce of America, Inc., New York City. Price $5.

This is the seventh annual edition and, in comparison with previous editions, it shows a steady development of air travel, though the gain is not spectacular.

Among the interesting high spots in the volumes is the detailed account of the round-the-world flight. The air mail also receives careful attention and gives one an even better appreciation of the service than is obtainable elsewhere. A photograph of the worst section of the Allegheny mountains, over which both the day- and night mail travel, makes one realize the dependability of both the planes and the pilots.

The growth of aërial photography as an aid to mapping, surveying and laying out projects of various kinds, together with its use in appraising values of taxable areas, has proved its worth in a number of cases, saving much time and securing greatly increased revenues for the state.

It is impossible to even mention all the parts of interest covered by this year's volume. The needs of commercial aviation are carefully considered and attention is given to the developments of the year in aviation instruments, engines, planes and equipment generally. The need of a substantial source of supply for aircraft, which means a steady flow of orders from governmental departments at present, is pointed out. All who are interested in the development of aviation will find the book of great value.

Machine Shops on Wheels

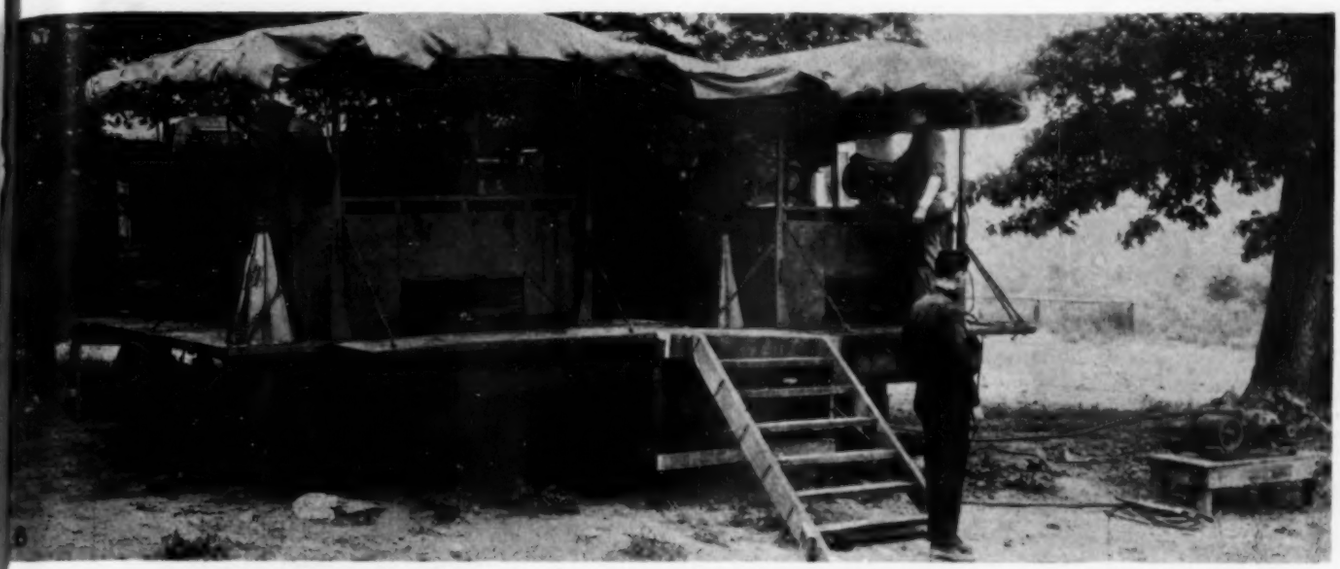
Mobile Ordnance Repair Equipment Demonstrated at the Seventh Annual Meeting of the Army Ordnance Association, Aberdeen Proving Ground, Maryland, October 2, 1925

Above—Ordnance Maintenance Company on the march *Below—Supply trucks set up for operation*

3—The headquarters and supply section

4—Gasoline truck and its warning sign

5—The office truck opened up



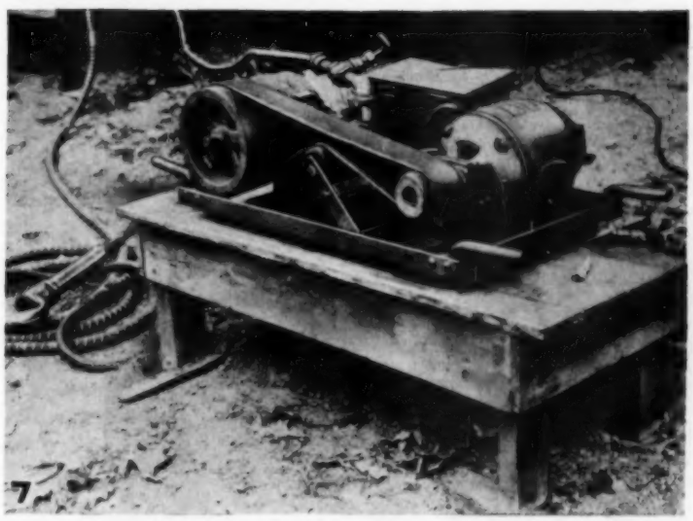
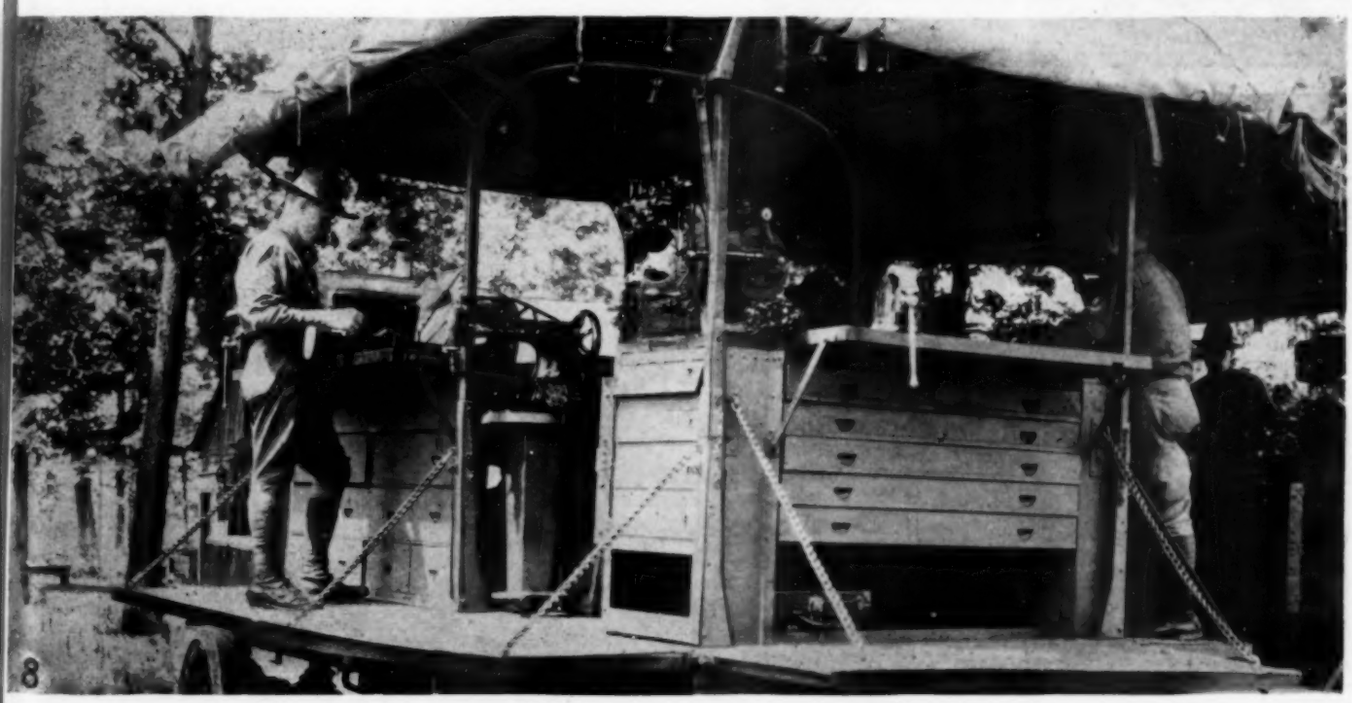


Fig. 6—Artillery repair trucks operating in tandem

Fig. 7—Close-up of the compressor

Fig. 8—Small-arms repair truck in use



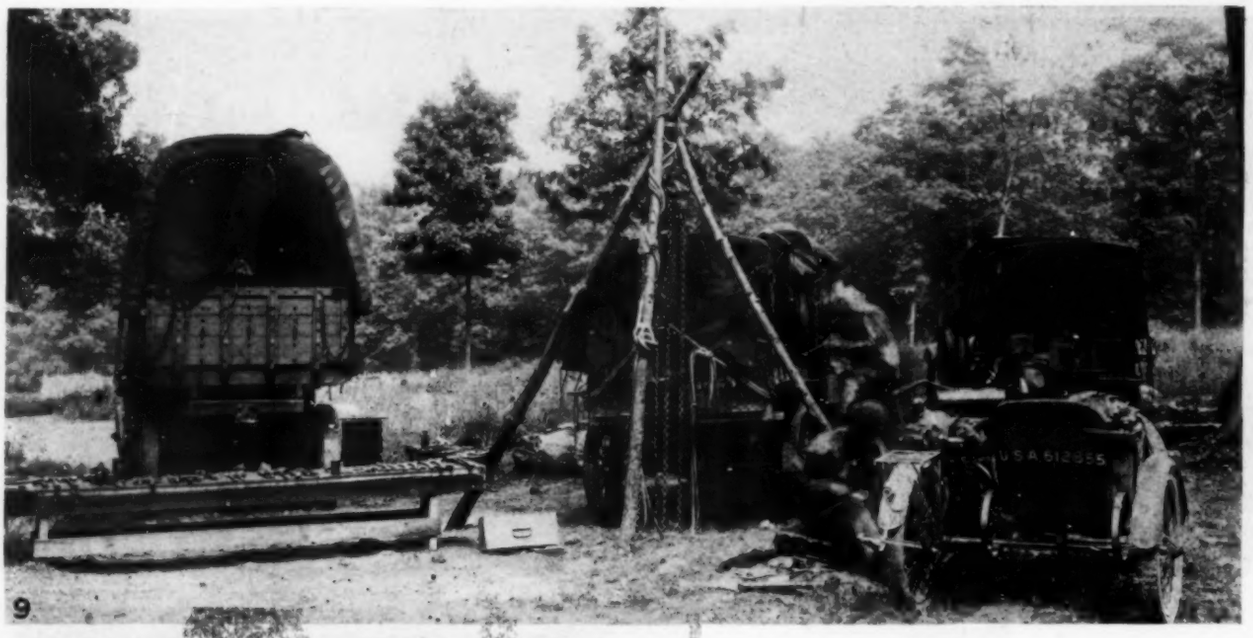
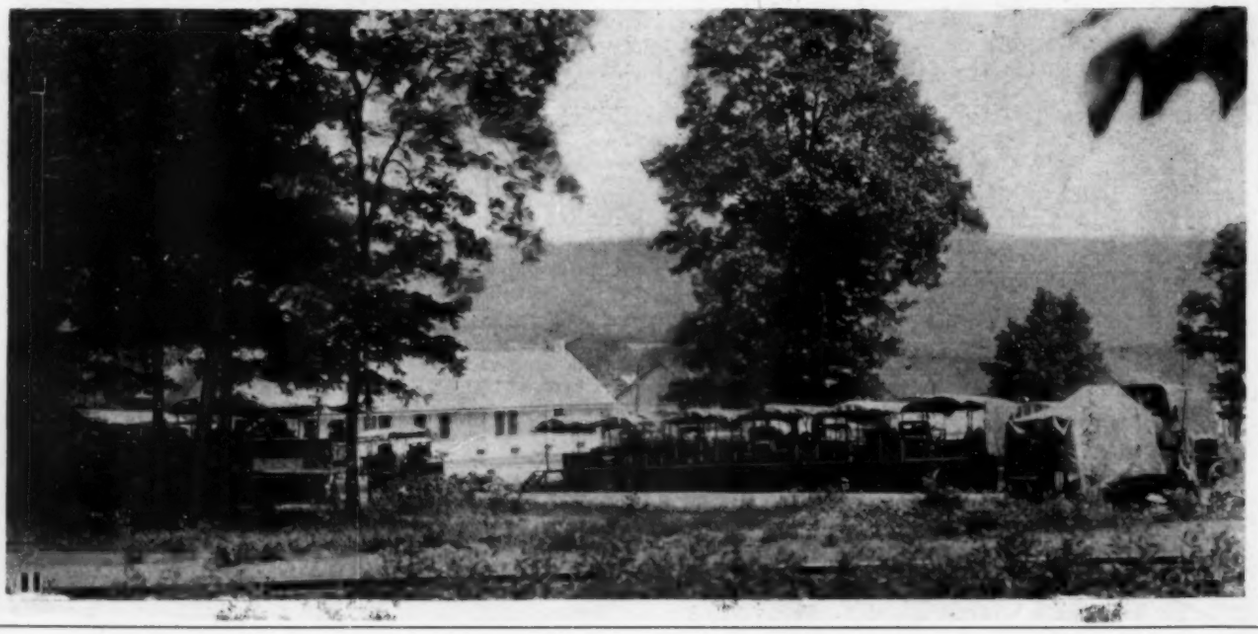


Fig. 9—Ready for heavy repairs

Fig. 10—Gas welding in the field

Fig. 11—The company in camp



Automotive Production

Co-ordinating Designs and Production Methods in Gear Development

By Perry L. Tenney
Muncie Products Division, General Motors Corporation

Solving gear problems by co-ordination—The metallurgist assists in the choice of steel—Dynamometers show characteristics of teeth — Problems of heat-treating

THE manufacturing side of the automotive industries and especially the gear manufacturing shops have been subject to frequent "storms" of trouble, which seem to arise from nowhere and, unfortunately, to disappear in the same place. I refer particularly to the periodical recurrence of problems of gear noise and wear that every so often seem to throw the gear shop into a turmoil for no specific cause; and, after the shop quiets down, it is hard to say just exactly what was done or what assurance there is that it will not reoccur. Men who have been connected with the transmission end of motor cars, either directly or by association, will undoubtedly recall several such experiences of their own.

Much has been written and discussed about the mathematics and geometry of gears, which should overcome all of this, but unfortunately it never has. I am taking this up purely to present a novel experience in the clearing up of one of these "storms" of more than average violence, that struck our organization some two years ago and that offered an opportunity for a more thorough analysis than its predecessors.

Everyone Has Trouble

Along with the analyses of our own shop conditions came the usual suggestion that we use such and such a process or such and such a steel because "so and so" used it and never had any trouble. Probably, everyone has heard these statements made and if the time is taken to run them down, it is found that "so and so" has about as much trouble, whether it is of the same nature or not.

I have always given large consideration to the fact that any present commercial development is the result of the evolution and co-ordination of several branches and that no one man or no one branch is in itself capable of accomplishing anything without the understanding and co-ordination of several of their associate branches, also that this evolution in the motor car industry has been at times too rapid to permit the proper recasting of the situation when some new feature is introduced, and I believe that it will be agreed that this is the source of many of our problems today. Our present motor car transmissions are a very fine example of this evolution. The materials we use, the designs we use, even the functional requirements are a sum of the developed demands and the process of the material available, and most of the major steps have come to pass through commercial expediency and not through previously laid down figures of the designer.

Co-ordination of Processes

A laboratory and dynamometer analysis of our product showed that it was in every way up to the average as compared with several specimens of our contemporaries' output. We found evidence that the other fellows had troubles very similar to ours and their answer was about the same. They were using the best materials, designs and processes that they had been able to develop.

Throughout our entire preliminary investigation there was evidence that if we could co-ordinate the high points found in each specialty from the steel mill, through the heat-treatment, through the details of tooth form, through mathematics of gear action, and the process of manufacture, some big strides could be made both in the performance and in the cost of the product.

Realizing to what extent the present product was the result of adopting one commercial development after another, and also to what extent our entire industrial substance had been built up through the purchase of equipment and the training of men along the established lines, we endeavored to abandon all loyalty to the present status of things and to assume that, should we be called upon to design the best transmission judged from the horsepower-hours and dollars stand-

Paper presented at the Production Meeting of the Society of Automotive Engineers, Cleveland, Sept. 14-16, 1925.

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point, we did not know what materials to use, what process to use, or what size to make it. This may seem a startling statement, but put aside your own prejudice to your own lines as you have developed them, and ask yourself the same questions.

In every case the answer is, we are following our present practice because it is the best way we have been able to establish for our shop to date. It is true that the engineer may have certain designs that he believes would be better, the steel mills may have other steels that they believe would be better, and so on through every branch, but until all of these can be co-ordinated the actual step in progress cannot be made.

To substantiate this, let us review a bit of history. The first horseless carriages used belts, frictions or gears to secure the desired driving ratios. The fact that gears could transmit the required power with very much less space and with much more reliability quickly eliminated the other means, and the motor car maker turned to the gear specialist for his best product. He took what we might call the Brown & Sharpe 14½-deg. pressure angle, involute-form cut gear. These gears were all of the interchangeable system, not because the interchangeable system was the best thing for the motor-car transmission, but because the best gears developed to that date were developed along the interchangeable system. Wear on the soft steel gears in planetary and individual clutch type of transmission and the advent of the sliding-gear transmission immediately called for a hardened gear tooth. The best commercial development available was the packhardening of low-carbon steel. This material, however, had such a low permissible stress that when used on the 14½-deg. pressure angle involute tooth of full depth it made stripped gears the nightmare of the motorist.

> The gear manufacturers, like others, often follow the present practice because it is the best that has been developed to date, not because it is correct or even very successful. Periodical upheavals bring about the reopening of problems of gear design. During the latest "storm" this organization more deeply analyzed gear production problems.

The gear maker answered this with a 20-deg. pressure angle stub-tooth involute gear, still of the interchangeable type, which, having a broader base and a reasonable gear action, did much toward overcoming the stripping of teeth. A few makers at this time went a step further and developed the 20-deg. pressure angle, full-depth tooth, which gave a better gear-tooth action and sacrificed very little on strength; however, I believe that up to very recently the 20-deg. stub tooth has predominated in the motor-car transmission field.

As quantity production gained, we began to feel the commercial shortcomings and hazards of the packhardening process and we welcomed the advent of high-carbon alloy steel, which became available in 1911 at a price that made its use commercially practical. It is true that many of these steels were known years before, but their price was prohibitive. Also the treachery of handling with any equipment then available barred them from serious consideration. After the advent of the high-carbon alloy steels, did we check back to find the best tooth form to use to take advantage of the physical characteristics of this steel? We decidedly did not. We continued with our 20-deg. stub tooth because this was the best that we had developed to date. We accepted what pitting and wear we got as inherent in this type of steel.

Some few of us continued with the packhardened gear. Then, alloy steels became available, allowing the adherents of this method to hold their ground in competition with those adopting the high-carbon, oil-treated steels.

Under the commercial pressure for lower cost and lighter units, we began calculating closer to the higher stress values of our alloy steel and making our transmission smaller, finally getting to a point where wear and pitting become serious factors. A few manufacturers, realizing that the full-depth tooth had a better wear value and a better tooth action than the stub tooth, went back to the use of 20-deg. pressure angle, full-pitch teeth on all gears or at least on the intermediate and countershaft constant-mesh gears, thus making half a step in the right direction. From several conferences I have attended and from discussions I have had with gear makers, outside of a few individual shops, this problem is still before the gear-making fraternity. I believe its only cure is in co-ordinating the efforts of all divisions involved. In the following I will give the results of some of our efforts in this direction.

As stated earlier in the paper, the shop was in trouble. Now, we have not left them floundering around for any length of time, for most of the foregoing points were presented and thrashed out in a conference, and it did not take much longer than the reading of these items. The valuable feature is that we could lead the shop step by step as our dynamometer results came on. The first accusation to be answered was that our gears wore and pitted because they were soft. This came about through the tendency of the shop to run to the low range of the hardness specification as a precaution against distortion. We were using a chrome-carbon steel of 5,150 S.A.E. analysis, having some years previous substituted it for a chrome-vanadium, No. 6,145 steel originally used. Short runs on the dynamometer readily showed that within a liberal range either side of the specified hardness there was no appreciable change in the wear value, and going a step further, we water-quenched some of this steel to 96 Shore hardness and got practically the same pitting and wear value as we did from soft specimens at 65 Shore hardness, thus we immediately relieved the shop of the soft gear trouble.

The next step was to determine the very best treatment for the steel we were using. Upon finding the

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highest performance of our 5,150 steel we checked this by similar test through practically the entire series of high-carbon, oil-hardening steels. In every case a metallurgical representative from the steel mill source worked with our metallurgist so as to take advantage of all the knowledge available for getting best results of each type of steel. In these tests we went thoroughly through chrome-carbon steel, chrome-vanadium, chrome-manganese, manganese-molybdenum, and chrome-nickel, using lead-pot, salt-bath, cyanide and electric-furnace heat-treatment. In some cases the steel was furnished to us in the roll-bar, and carried through the forging, normalizing, machining and final treatment under the combined supervision of a steel mill metallurgist and our own. In other instances the forgings were taken from stock of the manufacturers using these steels, the normalizing was done in their plant under their supervision, forgings were forwarded to us for machining, returned to them for final treatment and finally returned to us for dynamometer test. All through these tests the same gears, the same tooth-form, the same dynamometer loads and speeds were maintained. Special attention was paid to the cyanide heating of these steels since it was found that two of our contemporaries were using this type of steel and getting outstanding results.

The detail of these runs would make quite a long story. The conclusion reached was, however, that there appeared very little difference in the performance of any of these steels with normal treatment. The two outstanding features were the high wear-value of cyanide-treated chrome steel and chrome-vanadium steel.

Cyanide-treating of a 7-9-pitch gear set upon which we were having trouble from period noise that occurred after very slight wear allowed the shop an immediate way out. The dynamometer test of this gear set showed that pitting on the original treatment was traceable within 2 hours and that the average life of this set was 8 to 10 hours on full-rated dynamometer load, whereas the same set cyanide-treated without any other modification gave an average life of 30 hours.

This series of tests gave the basis for probably the most vital information required for motor-car transmission design, that is, the ratio of dynamometer hours to thousands of miles of field-operation of the car.

By some fifty comparisons in which transmissions of known mileage, in known territories, were compared with the dynamometer, gears of various stages of wear with known load and time were checked up, together with a comparison of material analysis, impact value, structure, and hardness. A low value of 1,000 miles car-use per hour of dynamometer load in intermediate gears was established and a high value of 8,000 miles of car-use per hour of dynamometer load in intermediate gears was found. All figures indicated a safe average of 3,000 miles of car-use per hour of dynamometer load in intermediate gears. In giving this average for passenger car service, we do find that passenger cars used in stage coach service in mountainous or sand-road localities demand the lower figure.

The study of the characteristics of the wear of the first series of dynamometer tests revived interest in some calculations and tests that we had made on modified addenda gears, but in which we had not been able to interest any one. This is another example of the necessity of co-ordinating these bits of knowledge before definite steps can be made. Having determined the values of various heat-treatments and steels in the stub-tooth form, we next applied full-pitch, 20-deg. pressure angle, involute teeth, using only the most favorable, however, of the previous combinations. These tests resulted in finding that with an electric-furnace treatment on chrome steel, wherein a 7-9-pitch gear set would show signs of pitting in 2 hours and would show a total life of 10 hours, that a 7-pitch gear-set of otherwise the same dimensions and treatment would run from 26 to 30 hours before showing signs of pitting.

In measuring the life of a gear set, we determined by comparison with field-test jobs the amount of wear permissible before objectionable noise occurred, setting for a standard the point at which the gears would be replaced if the car were being overhauled. We also found that the cyanide-treated, chrome-vanadium, 7-pitch gear set with otherwise the same design practically eliminated pitting and that its life was from 100 to 125 hours before any perceptible wear showed, and that better than 200 hours could be counted on as an average life of the gear. A 3½ per cent nickel pack-hardened 7-9-pitch gear run on the same test lasted 72 hours before a noticeable wear showed and had an ultimate life of 150 hours.

The same general characteristics apply not only on the fine-pitch passenger-car units, but to the heavier-pitch heavy-duty truck gears as well, although the exact ratios are not maintained; that is, in the heavier pitches for heavier duties the differences between these gears are not so great, as shown by test on the lighter-duty gears; however, we have not gone far enough into the heavy-duty tests to determine the exact value.

> The only cure for the difficulties of making gears capable of hard service with smooth action and designed close to the high stress values of steel is to co-ordinate the efforts of all divisions involved in their production. The metallurgist and the heat-treater must stand ready to assist the designer in refining the construction of gears

Returning to our modified addenda set, it was quite apparent that wear on our gear teeth bore definite relation to the square inches of active tooth, rather than merely to the pressure per lineal-inch on the tooth. This led us into an endeavor to make the square inches of active tooth surface on each pair of gears as near equal as possible; that is, to make the active tooth-face on a pinion as much greater that the active tooth-face on its mating gear as its ratio to that gear. By balancing out a transmission design in this manner we have

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been able to take 20 per cent off the weight of a transmission of a given capacity.

Further on the subject of co-ordinated activities our reactions on gear tooth grinding may be of interest.

Some three years ago our organization reacted to the logic that gear teeth should be ground for the same reason that shafts and other parts are ground and that the only thing that kept us from doing it was lack of suitable machines; another case of the necessity of co-operation between the machine-tool builder and the designer. It is unquestionably just as illogical to run together hardened gear teeth that have merely been hob or shaper cut and put through the fire, as it would be to put a good lathe-finish on a shaft, put it through a heat-treatment and try to assemble bearings and other running parts; and in spite of some of the differences that may be drawn in this comparison, we still believe in grinding, although we are doing very little of it at present.

At the period first mentioned we inspected the entire field of gear-tooth grinding equipment then offered and, being firm believers in the generating process, we selected and purchased a battery of machines that appeared to be fundamentally correct and that gave very good results on demonstration.

These machines did very creditable work in salvaging, but we were unable to get down to a good commercial picture by their use; in fact, it developed that by using these grinders as a club over the production end of the shop, we could consistently cut as satisfactory gears as we could grind.

Shortly after our original purchase we inherited from a sister organization part of a battery of a newer type of generating grinder and got about the same reaction as from our original installation; our findings being that, while both of these machines and their generating principle were all right on paper, we could not keep them working in the shop. In addition to that, we had considerable wheel trouble on which the grinding wheel people themselves seemed unable to help us. The curve-generator mechanism is not of sufficient ruggedness to maintain its accuracy under shop-production conditions. Also, it appears that the method of taking the cut violates good grinding practice and presents a grinding-wheel condition with which the abrasive manufacturers are not able to cope.

The furnishing of ground gears to meet the need of a quiet running installation having a very exacting backlash requirement caused us to look into the form-wheel type of grinder.

In spite of all the niceties of the generating outfit, we found that we could consistently get accurate gears only from the form-wheel type of machine. The apparent reason was that approved grinder construction and approved grinding wheel practice is not violated; also the degree of accuracy required is merely a matter of reasonable machine maintenance and proper attention to the forming device. Therefore, today, the form-wheel type of grinder is far closer to the commercial picture than any other type; however, it is again proved to be a matter of the proper co-ordination of the machine tool-builder, the abrasive wheel maker and the transmission maker to bring about the day when all gears will be ground on the teeth.

By getting the fullest co-operation from the steel mill, the forge shop, the heat-treating and metallurgical departments, the machine tool builder, the cutter maker and the engineer, we have been able, step by step, to solve the immediate problems of our shop and our customer, to prevent the reoccurrence of any "storms" to date and to have fewer clouds on the horizon, and also greatly to improve our product without adding to its costs. In fact, in most instances we have lowered detail costs and the most valuable accomplishment is to have brought about a spirit of co-operation in the shop and with the customer, high above the average.

Jigs and Fixtures Applied to the Machining of Engine Blocks

By J. G. Moohl
Cleveland Automobile Co.

IN DESIGNING jigs and fixtures for large or medium production there are several factors the tool engineer must consider, among the most important being the accurate location of the work, firm but rapid clamping facilities and loading means, reduction of expense by similarity of patterns, bushings and other parts and the general design of the fixtures themselves. This article will attempt to describe very briefly how these points are carried out in machining engine blocks at the Cleveland Automobile Co.

In that organization it is considered that co-operation between the engineering department and the tool-engineering department is of utmost importance, and in line with that idea it was decided that the tool engineer should determine the position of locating points for machining operations on the engine block. The first operation consists of milling the top, side and bottom on an Ingersoll milling machine for which the location of the work in the fixture must be made from cast surfaces. These surfaces are checked on a target fixture. In the second operation two ¾-in. locating holes in one side of the bottom flange are drilled with a combination drill and reamer. These two reamed holes are then used for locating purposes in every subsequent operation, and accumulation of errors is thus prevented. To insure long life and successful operation of the jigs these holes must be large enough so that the locating pins and dowels may be of ample size to withstand wear and strains. Disappearing dowels are used throughout so that loading may be accomplished by

Paper presented at the Production Meeting of the Society of Automotive Engineers, Cleveland, Sept. 14-16, 1925.

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sliding in the heavy casting on hardened strips without lifting it over any protruding dowels or pins. The disappearing dowels, operated by a rack-and-pinion arrangement, work in standard interchangeable slip bushings of a type which is used in every possible application throughout the shop, over one thousand having already been put into use.

In determining the means of clamping and loading the work the designer has a large variety of methods at his disposal and to insure the best possible design he should consider a number of ways for accomplishing the same result and select the one most suitable for speed, safety, economy and durability. A jig that is not quick-acting will usually prove to be a costly piece of equipment. The average reloading time for all jigs in the engine block department at the Cleveland Automobile Co. is 12 seconds. For heavy work, such as motor castings, if all obstructions over which the piece would have to be lifted are eliminated and stops used to locate it approximately, the loading time will be greatly reduced. Clamps operated by cams are in most cases quickest and most satisfactory except for milling operations, where something more solid must be used.

Saving at the Drawing Board

In order to equip the plant with jigs and tools, by a limited expenditure of money, the tool engineer must resort to every available cost-reducing means he can. Much can be done right on the drawing board, and by adhering to certain principles of design the cost may be reduced considerably without detracting from the usefulness of the tool. In general, a number of operations on the same piece may be performed with jigs having bodies cast from the same pattern. Since patterns represent a large part of the cost of a jig, much expense may be saved in this way. Frequently a whole series of jigs may be designed so that by changing a boss here and there, or perhaps adding a loose piece or two, one pattern serves for the jig bodies of all. Six jig bodies used in machining Cleveland Six engine blocks were cast from the same pattern, and all along the line the different jigs have been kept as closely alike in design as possible, the only substantial difference in many cases being in the bushing plates.

Appreciable expense is also saved by using in every possible case a single type of standard removable liner bushing. The bushings are generally the first part of the jig to need replacing, and those of a standard interchangeable liner type are easily obtained and easily replaced. To replace a drive-fit bushing usually the entire jig must be removed from the machine, taken to the toolroom and at least partially dismantled and a new bushing be made to fit the hole. But a removable liner bushing kept in stock in standard sizes requires that the machine be stopped a maximum of only 2 or 3 minutes while the old one is lifted out and a new one slipped in without the aid of a single tool. The loss of time to the machine is therefore a matter of a few minutes against perhaps a half day.

By using duplicate clamping parts, handles, knobs and screws on as many jigs as possible, not only will much time be saved in the drafting room but also a smaller stock of replacement parts will be needed.

In the general design of a fixture the consideration of strength and rigidity must be kept in mind at all times. There is seldom any point in holding down weight and the addition of 100 lb. of metal will cost only a few dollars and may save several hundred dollar's worth of grief later. The base, or jig body, should be of a heavy section well ribbed and made as nearly as possible like a surface-plate. This will leave little possibility of warping and throwing locating points or bushings out of line. Bushing plates should be designed with deep enough section or ribbing to prevent warping and should have plenty of supporting length for the bushings. They should be so attached that there is no possible chance of their moving out of alignment. Sufficient chip clearance should be provided between the fixture and the work to facilitate the rapid cleaning of the equipment.

It is also important that all locating surfaces be self-cleaning. This must be accomplished in a variety of ways to suit the conditions, but in general, surfaces may be sloped away from horizontal locating points, so that chips will roll away. Vertical locating surfaces usually can be placed high enough above any horizontal surfaces so that chips will not accumulate in front of them. Wherever possible, openings should be provided in the wall of the fixture below these surfaces to allow chips to fall out.

A Fifty Per Cent Economy

As an example of the extent to which co-operation between the engineering and tool-engineering departments may be carried, the matter of boring cam and crank holes in the Cleveland Six engine block may be cited. This is a three-bearing job and, at the tool engineer's suggestion, the cam and crank bores were designed in steps, that is, starting at the front, each successive bore is stepped up to a slightly larger diameter, and with this design a much more efficient method of boring is made possible. The work is done on a double-end machine with Kelly-type bars, two of which are long enough to reach the center cam and crank bearings. In the ends of these bars are sockets to take the shank of a core drill the same diameter of the rough bore of the center bearing. The successive cuts are as follows: The core drill first cuts out the rear bore, followed by a fly-cutter rough-boring it to a larger diameter as the core-drill cuts the center hole. Meanwhile a similar core-drill cuts the front hole to its rough-bore diameter from the opposite end. In this way removal of cutters from the bar between bores is eliminated. The fixture supports the bars in bushings, one outside of each end hold and one just back of the center. The bushing at the rear end is fitted with an inner bushing which is keyed to the bar and rotates with it. It is slotted for the passage of the Kelly cutter. It is estimated that this method represents a saving of time of about 50 per cent over the usual way where all bores are of the same diameter and cutters must be removed from the bar and inserted again between the bores. The finish boring is then done on a single-end machine with removable bars and fixed cutters. The feed is reversed in this case, the bars being pulled toward the head instead of pushed from it.

Repairing a Cast-Iron Gear—Discussion

By O. P. Williams

REPAIRING cast-iron gears, such as building in new teeth, and welding the hubs, spokes and rims by the oxwelding process, is one of the common, every-day jobs confronting the welder. A great deal has been written on the subject, and the latest article of interest I have noticed was written by F. H. Ryan and published under the title given above, on page 1010, Vol. 62, of the *American Machinist*.

In the opening sentence, Mr. Ryan stated that "the welding of cast iron by any process is a difficult matter, and the results are more or less uncertain, due to the fact that the heat necessary to do the welding, changes its structure." He then goes on to tell of the difficulties regarding brittleness and hardness encountered by him in building in teeth by electric welding.

I confess that I do not know a great deal about electric welding, but was interested in his method of embedding steel studs and fusing the ends into the weld metal, using a steel electrode. However, I do know that Mr. Ryan made a pretty bold statement when he said "the welding of cast iron by any process is a difficult matter, and the results are more or less uncertain."

To those familiar with oxyacetylene welding, cast iron is one of the easiest metals to weld successfully. By the use of the correct welding rod, and by simply heating and annealing the entire casting, gray cast-iron welds can be made as soft and readily machineable as the original metal itself. The weld metal is not "brittle," in any sense of the word, and the weld is as strong as the rest of the casting.

Preheating Not Necessary

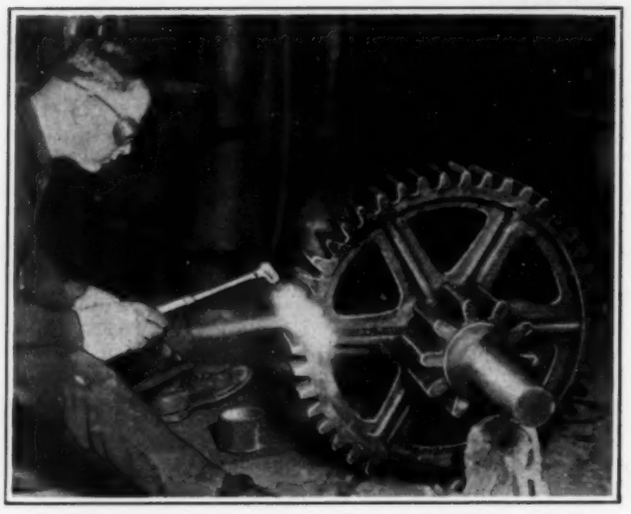
In oxwelding new teeth in a cast-iron gear, preheating is not necessary if the gear is small. The casting receives enough heat from the welding flame to avoid chilling the added metal. However, if the face is over 3 in. wide and the rim more than 1 in. thick, the gear should be preheated. Preheating can be done in a temporary furnace of loose brick, enclosing a charcoal fire.

Some welders shape carbon plates to the exterior form of the tooth, in order to aid in controlling the molten metal, while many do not find the need for such a device. In any case, the base of the new tooth is heated with the flame, and one edge then melted. The cast-iron rod, previously dipped in Ferro-flux, is then inserted in the molten puddle. As the flame advances, melting the base to insure thorough fusion, the rod is added to the molten puddle until the other edge is reached. This foundation layer finished, the first edge is again melted, and a second layer oxwelded to the base.

This succession of layers continues until the tooth has been built up slightly higher than the adjacent teeth. In adding the weld metal, it is possible to build each individual tooth so near to its required shape that little or no grinding is necessary after it has been smoothed off with the flame and rod.

After the layers have been built up, the gear is turned so that the operator can fuse and smooth off the rough edges on both sides of the tooth.

The welding completed, the hot gear should be buried in hydrated lime in an annealing bin, or covered with powdered asbestos, or ashes. Large castings should be put into a charcoal fire and allowed to cool very slowly. By so doing the weld will be of good, gray iron, easy to machine. This simple heat-treatment, which is a common and accepted metallurgical operation for several different metals, among oxyacetylene welders, foundrymen, and blacksmiths, was disregarded by Mr. Ryan in his article on building in new teeth by electric welding. Proper cast-iron welding rod and careful annealing, are the chief reasons why gears having teeth built in by the oxyacetylene process have stood up in service for years after being repaired.



Building up new teeth in a bull gear

The illustration shows a welder building up one of six teeth that had been broken out of a gear belonging to a planer. All six new teeth were easily machined to an accurate contour. The gear is still in service.

Let the Draftsman See What Happens

By W. Edward

The chief draftsman had had an epidemic of calls from the shops to answer questions as to the intent of his drawings. He knew that most of his difficulties were due to new men on his force and yet he could not find time to correct their errors so long as he had to be out in the shop. It looked like a deadlock but there was one way out and he took it.

Instead of answering the calls himself he sent the draftsman who had made the particular drawing. He gave each draftsman instructions to make decisions, unless he was in serious doubt. He directed the shop foremen to go ahead according to these decisions as being authoritative from the engineering department. And he did one other thing which made his venture different from the many such attempts that have been started and have failed in the past.

He told each of the draftsman that the basis on which he went into the shop was to learn all he could of the valuable practical experience of each foreman rather than to try to cover any error on the drawing by an attitude that the shop was wrong.

The net result was a marked decrease in misunderstandings between the manufacturing and engineering departments, an increase of interest on the part of the draftsmen and a feeling of respect between the men at the board and those in charge in the shops.

Designing Forging Machine Dies

By A. C. Roepke
Tool Foreman, Los Angeles Shops, Union Pacific System

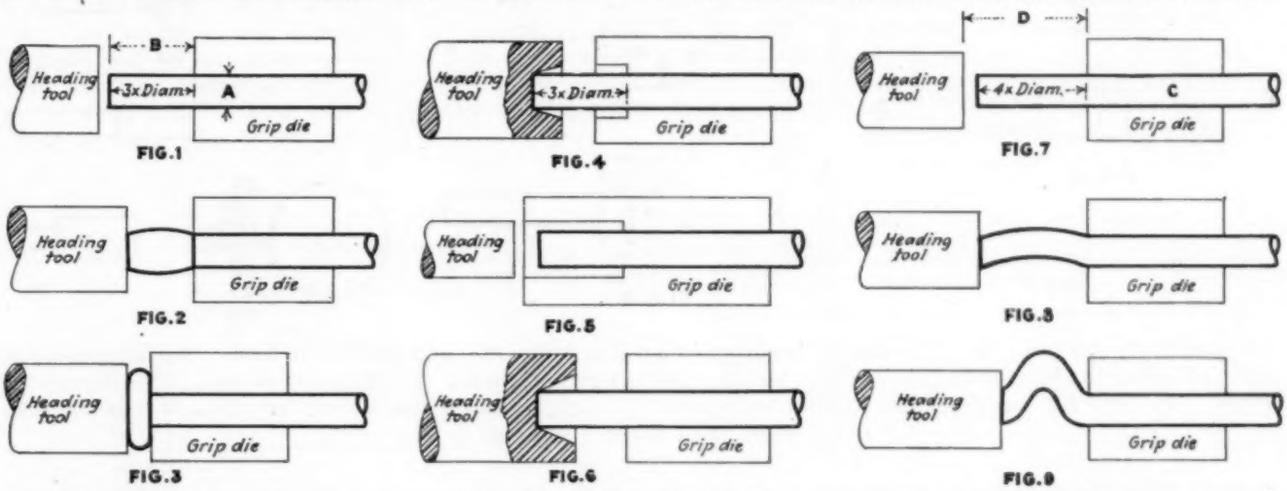
Methods of securing the desired upsets without buckling the work—Gathering metal to insure even distribution in the dies—Examples of various kinds

IT IS possible to classify the majority of forging-machine die problems under three rules, or headings, which are as follows:

Rule I—The limit of length of unsupported stock that can be gathered or upset in one blow, without injurious buckling, is not more than three times the diameter of the bar. As an example, by reference to Fig. 1, if the diameter of the bar *A* to be upset, is 1 in., then the length of unsupported stock *B* which may be successfully "gathered," cannot be more than 3 in. Since three diameters is practically the limit, it is best to keep the actual working limit within two and one-half diameters, and, where it can be done, even a limit of two diameters is better, as then less attention need be paid to the squareness of the end of the bar. On such upsets as indicated in Fig. 2, the stock will swell uniformly in all directions from the axis of the blank, and it can be carried to practically any thickness, such as in Fig. 3, without any serious tendency to upset unevenly.

It is immaterial whether the stock overhangs the face of the gripping dies, as in Fig. 1, or whether part of the stock is gathered in the gripping dies and part in the heading tool, as in Fig. 4. Whether it is all upset in the gripping dies, as in Fig. 5, or all in the heading tool, as in Fig. 6, it must be kept in mind that such conditions represent unsupported stock. If an effort is made to upset a length of stock longer than three diameters, the stock will buckle at a point near the middle, and result in more of the upset forming on the other parts. In Fig. 7, *C* is 1 in. and the 4 in. of unsupported stock will start to buckle as shown in Fig. 8, and the buckling will continue as in Fig. 9. It is impossible to correct this condition by varying the point in the die where the upsetting takes place. Figs. 10, 11, and 12 show that the stock will buckle, regardless of whether it is upset in the gripping dies, in the heading tool, or part in the gripping dies and part in the heading tool.

Rule II—Lengths of stock more than three times the diameter of the bar can be successfully upset in one blow, provided the diameter of the upset made is not more than one and one-half times that of the bar.

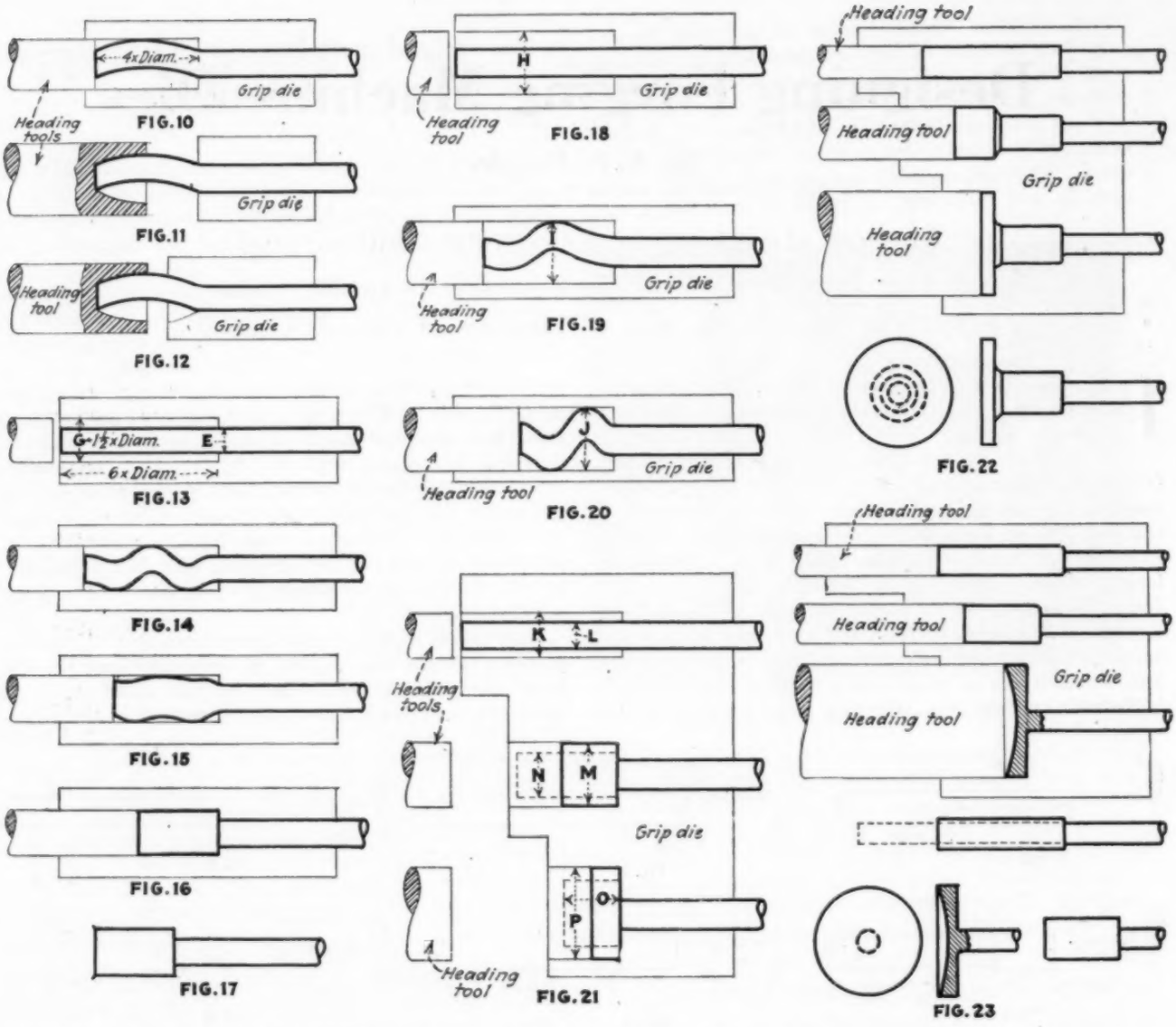


1—Ready to upset
2—Even flow of metal
3—Large and uniform head
4—Recess in heading tool
5—Recess in grip die
6—Recess in heading tool
7—Too long overhang
8—How stock bends
9—Bad flow of metal

This rule, while fairly well recognized, requires a clear understanding in order to develop its practical possibilities. Assume that in Fig. 13, the diameter of the bar *E* is 1 in., the length of stock to be upset is 6 in., and that the diameter of the hole *G* in the die, is not more than $1\frac{1}{2}$ diameters. When the upsetting begins, as in Fig. 14, the stock will at once buckle, but on account of the limited diameter of the hole *G*, the stock soon comes in contact with the sides of the die and further buckling is prevented. As the heading tool advances, the stock will gradually fill the die, as shown in Figs. 15 and 16, resulting in an upset as in Fig. 17, the only objection being a fin around the end of the upset.

If an attempt is made to produce a forging in a die in which the diameter of the hole in the die is greater

From a paper presented at the American Railway Tool Foremen's Convention, Chicago, September 2, 3 and 4, 1925.



10—Recess too large in die. 11—Recess too large in heading tool. 12—Bad practice in both. 13—Long upset in die. 14—How the bar bends. 15—Filling the die. 16—At end of stroke. 17—Fin left at end. 18—Recess too large. 19—How bar buckles. 20—Making bad upset. 21—Large upset in two stages. 22—Double upset in three dies. 23—Another example

than 1½ times the diameter of the bar, as in *H*, Fig. 18, the buckling is generally near the middle of the unsupported stock, such as at *I* in Fig. 19. Then the stock on the opposite side will fold in as at *J*, Fig. 20, leaving a defect in the upset. In practice, it is much better to keep the diameter of the upset not more than 1.3 times the diameter of the bar.

The practical application of this law is in the ability to gather large amounts of stock by repeating the principle, as indicated in Fig. 21. In the first, or top impression, the diameter *K* of the recess in the die, is not more than one and one-half times the diameter of the bar *L*. In the second impression, the recess *M* is not more than one and one-half times the diameter of the previous upset *N*. In the last impression, the length of the upset *O* is well within the limit of Rule I, regarding unsupported stock.

This principle is clearly shown in Fig. 22, where in both the first and second operations, the diameters of the impressions have been kept within this limit. The same principle applies to the first two operations in the upsets shown in Fig. 23. In such upsets, where the length of stock in the first operation is excessive, it is generally necessary to keep the end of the bar at a lower temperature.

It is sometimes desirable to carefully hold the size of some upsets in which the stock requirement is not materially over three diameters in length. If the diameter of the impression in the die is made not more than 1.3 times the diameter of the bar, as in Fig. 24, then the upset formed will be free from fins on the end of the upset, even if no special care is taken in heating. This is on account of the fact that where the length of the stock is not more than three diameters, the upsetting takes place quite uniformly throughout its length, and the buckling being limited, the friction of the stock along the side of the die does not become a factor. Forgings shown in Figs. 25, 26 and 27 come in this class.

In handling all upsets requiring more than three diameters of stock, it must be kept in mind that the stock will first start to buckle at the middle of the

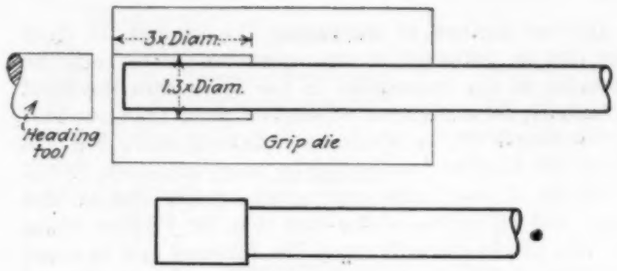


FIG. 24

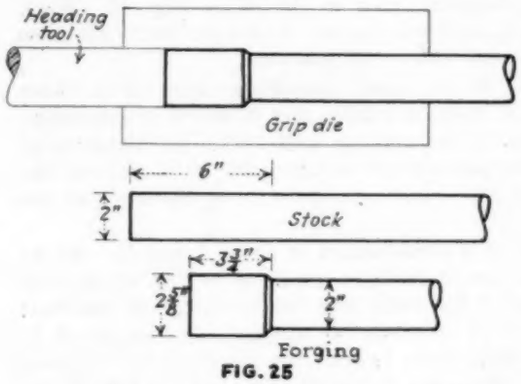
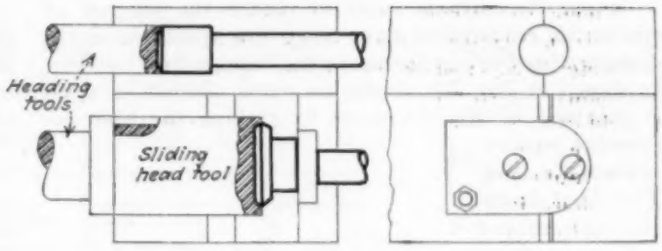


FIG. 25



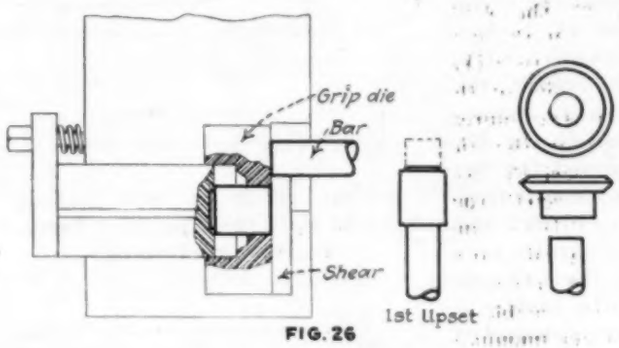


FIG. 26

24—A good upset. 25—Another good example. 26—Dies for flanged pieces

unsupported portion, and as a result, somewhat more than one-half the stock to be upset, as at *Q*, Fig. 28, must be inside of the impression in the die. It can equally well be in a taper or straight hole in the heading tool, as in Figs. 29 and 30. But it is useless to attempt to make part of the impression in the gripping die, and part in the heading tool, as in Fig. 31, because when the upsetting begins, as in Fig. 32, the stock will buckle, leaving a defective forging as shown in Fig. 33. To attempt to support the end of the bar in the heading tool helps a little, as in Fig. 34, but the final result, Fig. 35, will be a defective forging. A little study of these conditions will give several suggestions of considerable value about the design of dies.

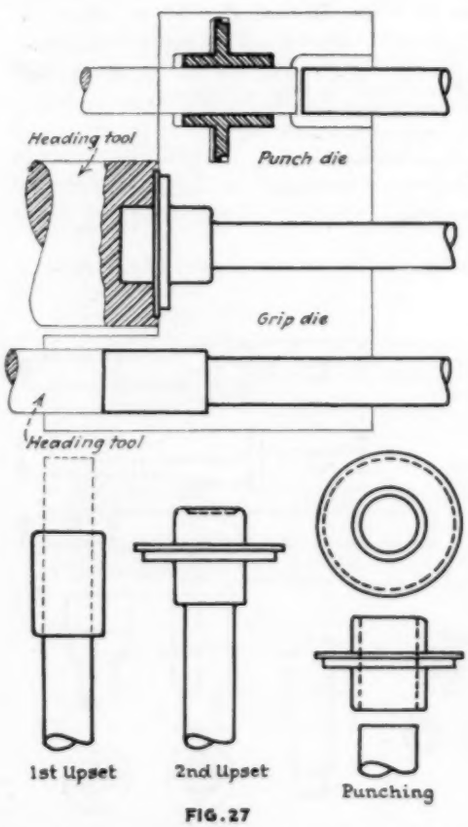


FIG. 27

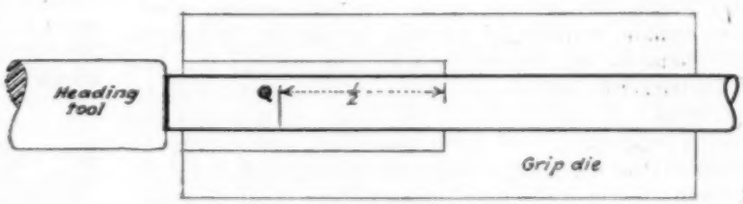


FIG. 28

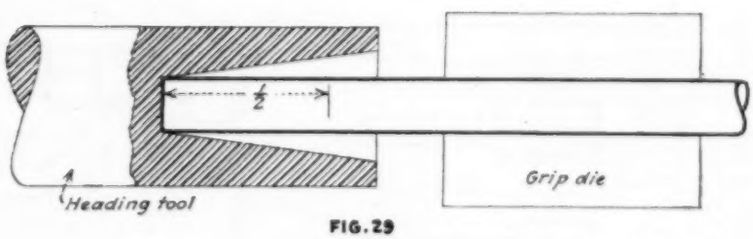


FIG. 29

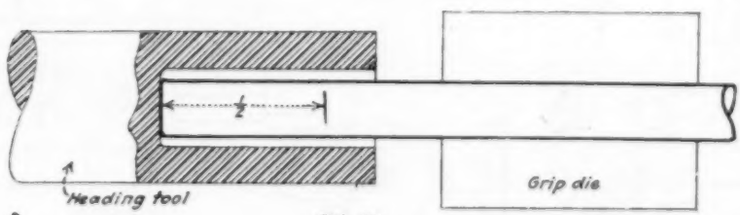
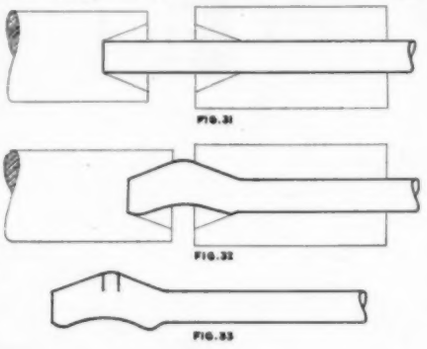


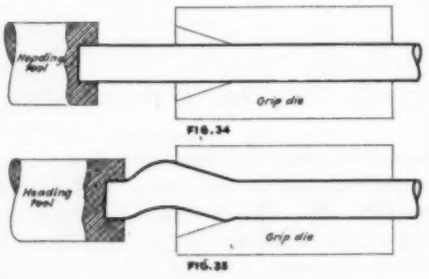
FIG. 30

27—Larger flanges. 28—Upset inside die. 29—Cone recess in heading tool. 30—Straight recess in heading tool

Among the various ways to reduce the number of operations required to make large size upsets on small-diameter bars, is one known as the "square-hole" scheme as shown in Fig. 36. Here, an extra amount of stock is obtained in the first upset by making the first impression square, in place of round. The short diameter of the square hole, as at *R*, is made within 1½ times the diameter of the bar. Consequently, the sides of the square impression in the die, support the bar and keep it from buckling, and the greater area of the square hole enables a larger amount of stock to be gathered than would be possible were the hole round. The next impression is made round, and the diameter of this impression, as at *S*, can be 1½ times the diameter across the corners of the previous square upset. The square corners by coming in contact first with the sides of the die impression, also prevent the bar from buckling, and allow a large amount of stock to be gathered. If the length of the stock as it leaves the second operation, has been shortened sufficiently to come within the requirements of Rule I, then it can be formed in the last operation into any desired shape, without regard to the diameter of the die impression. In Figs. 37 and 38 the practical application is seen.



31—Cone recess in both heading tool and die. 32—How stock bends. 33—Poor work results



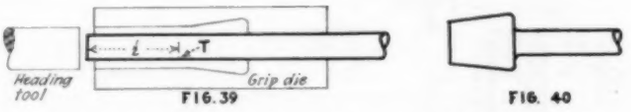
34—Another bad practice. 35—How it acts

Another method of increasing the amount of stock that can be gathered in one operation, is to keep the diameter of the impression in the die within the limit of Rule II, for a distance of slightly more than one-half of the length of the stock, as indicated at *T*, Fig. 39. When the heading tool begins to upset the stock, it will buckle at *T*, but being supported by the die at this point, and by virtue of the fact that the friction along the side of the die will cause the forward end to upset first, the stock will gradually carry back in the die and produce a uniform upset as shown by Fig. 40. Figs. 41, 42 and 43, indicate the use of this method. All three illustrations are full of suggestions.

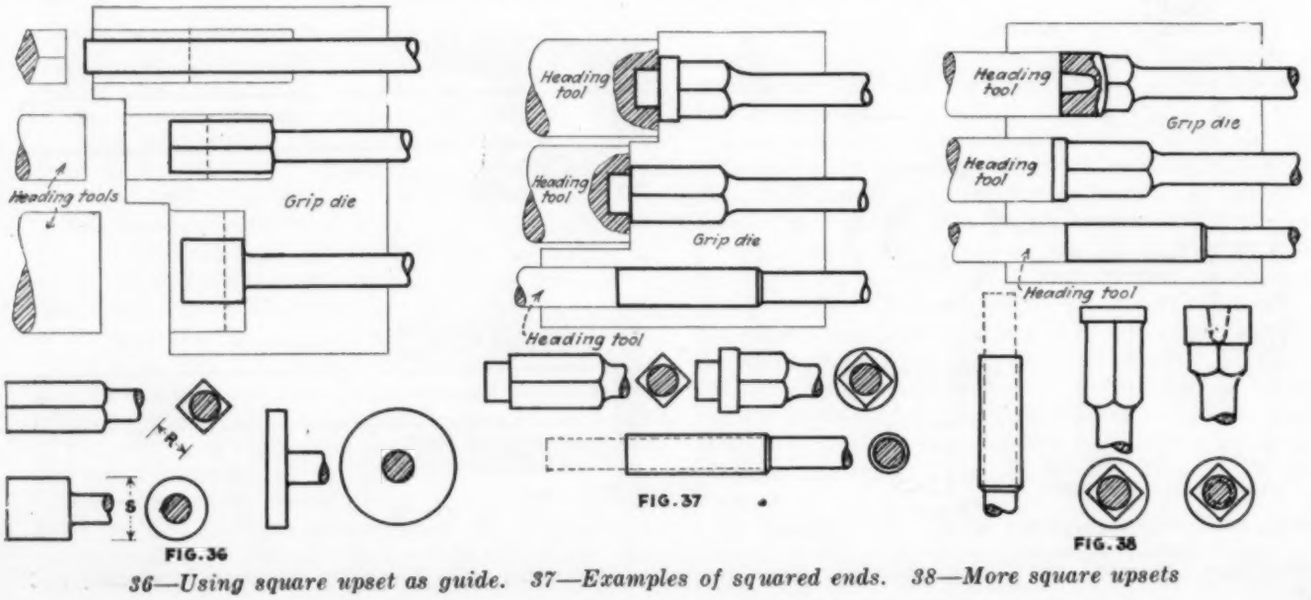
Rule III—In an upset requiring more than three diameters of stock in length, and in which the diameter of the upset is one and one-half times the diameter of the bar, the amount of unsupported stock beyond the face of the die must not exceed one diameter of the stock.

This rule is a combination of Rules I and II. As an example; if the stock to be upset, as in Fig. 44, is 1 in. diameter by 6 in. long, and the diameter of the hole in the die is 1½ in., then the amount of stock, as at *U*, extending beyond the face of the die must not be more than 1 in. However, if the diameter of the hole in the die, as in Fig. 45, is reduced below one and one-half diameters, then the length of the unsupported stock beyond the face of the die can be correspondingly increased. If the diameter of the hole in the die is not over one and one-fourth times the diameter of the stock, then the amount of stock beyond the face of the die may be increased to one and one-half times the diameter of the bar.

This rule also applies to cases where the upsetting takes place in either straight or taper holes in the heading tools, as in Figs. 46 and 47. If an effort is made to allow a greater amount of unsupported stock beyond the face of the dies, as in Fig. 48, the stock will buckle outside of the dies, as Fig. 49 shows.



39——Enlarging die at bottom. 40—The result



36—Using square upset as guide. 37—Examples of squared ends. 38—More square upsets

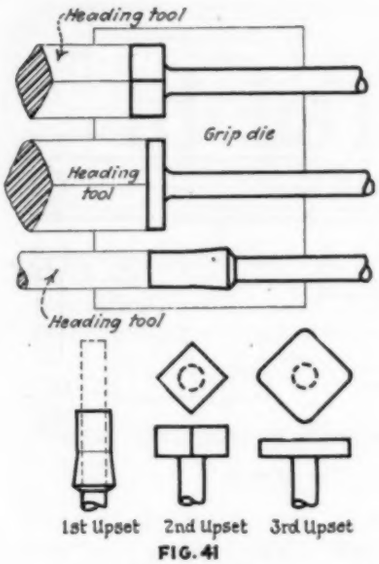


FIG. 41

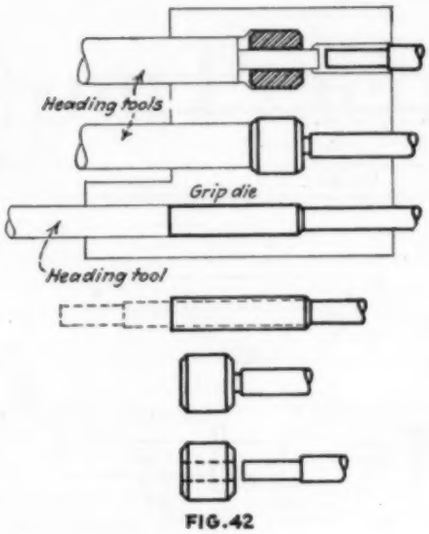


FIG. 42

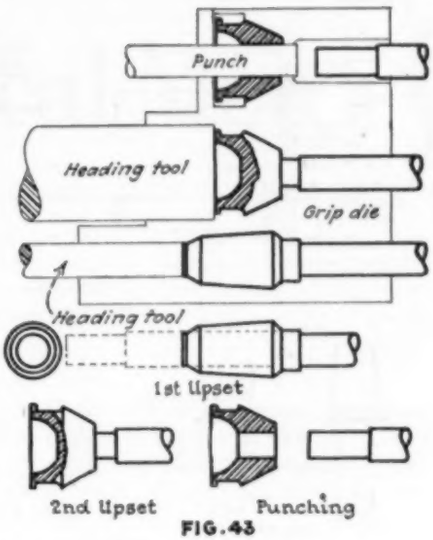


FIG. 43

41—Examples of square heads. 42—Punching work in dies. 43—Other examples of punching

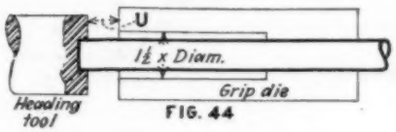


FIG. 44

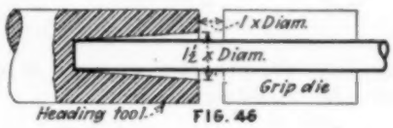


FIG. 46

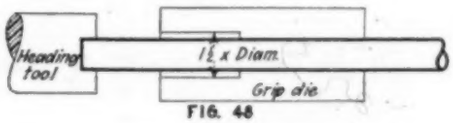


FIG. 48

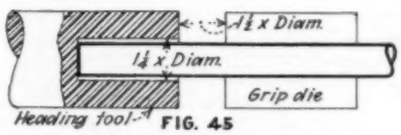


FIG. 45

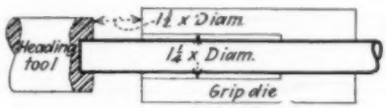


FIG. 47

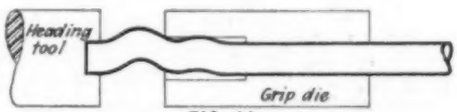


FIG. 49

44—Unsupported work. 45—Support in heading tool. 46—Taper recess in heading tool. 47—Small diameter recess. 48—Another bad example. 49—The result

It will readily be seen that such a limited travel of the heading tool, as at *U*, Fig. 44, would not provide sufficient stock to entirely fill the impression in the die, hence, in view of the limited heading-tool travel, on account of Rule III, many upsets can advantageously be made tapering as indicated in Fig. 50. The taper upset possesses many valuable qualifications, particularly, in that if the angle of the taper is approximately 4 deg. on each side, as indicated in Fig. 50, the increased diameter of the upset as the heading tool advances, increases the pressure in the direction of the bottom of the impression in the taper tool, and more fully insure a uniform and well-filled upset.

In Fig. 51, is shown how progressive-taper upsets

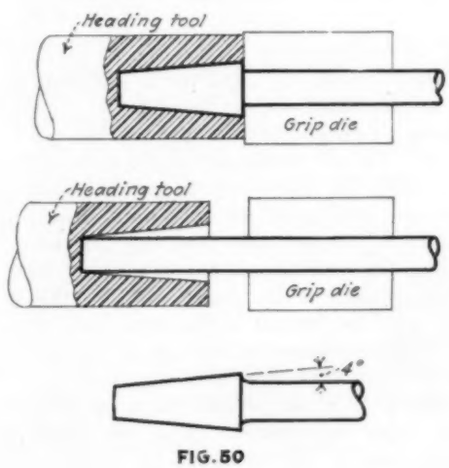


FIG. 50

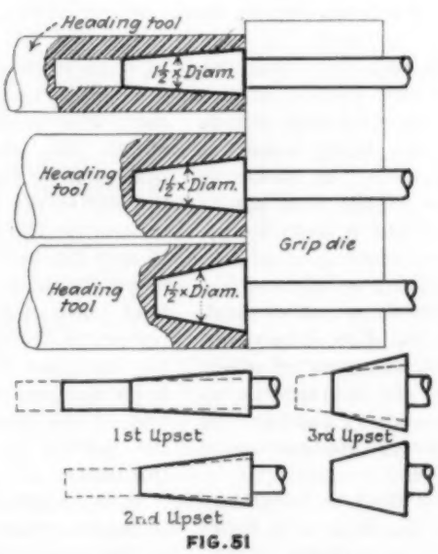


FIG. 51

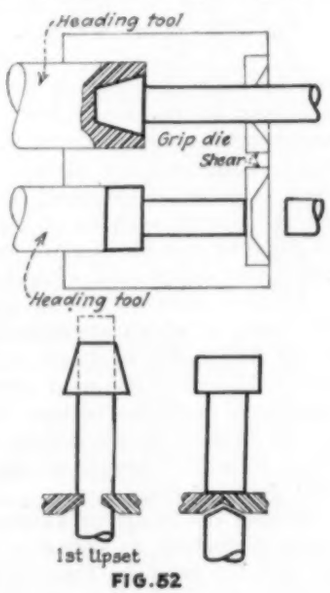


FIG. 52

50—Dies for taper upsets. 51—Examples of taper upsets. 52—From taper to straight

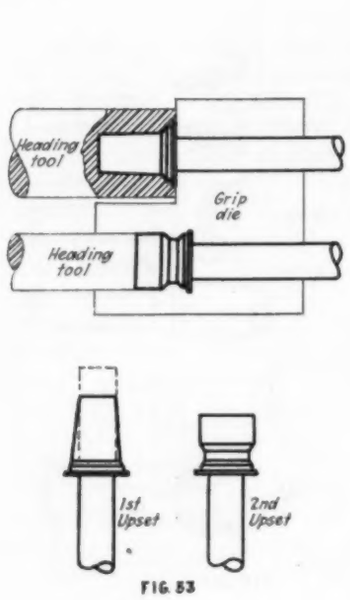


FIG. 53

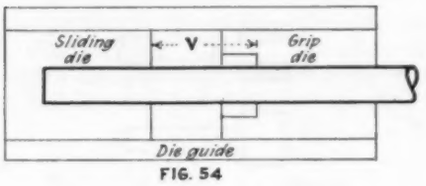


FIG. 54

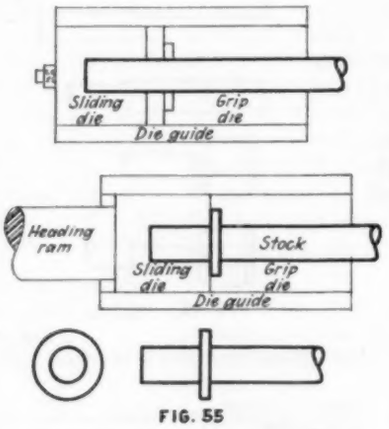


FIG. 55

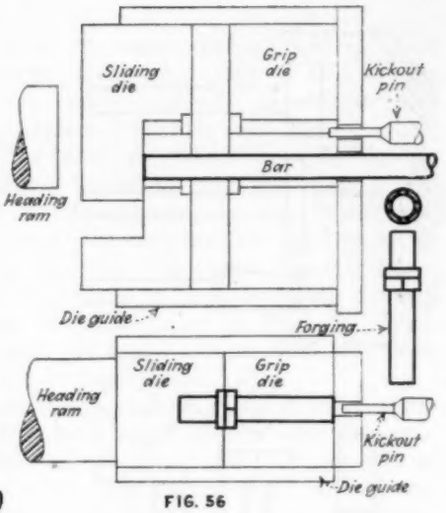


FIG. 56

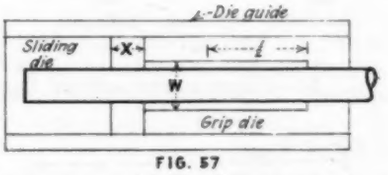


FIG. 57

53—Double operation upset. 54—Sliding die. 55—Another example of sliding die. 56—A combination. 57—More sliding die work

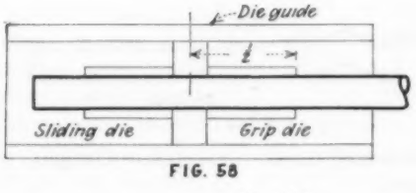


FIG. 58

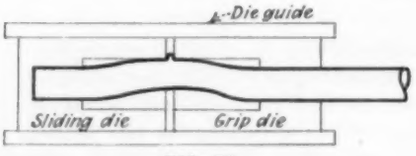


FIG. 59

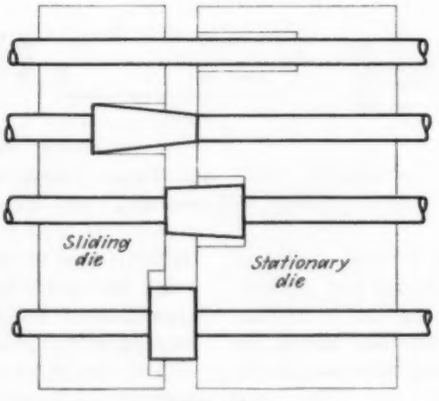


FIG. 60

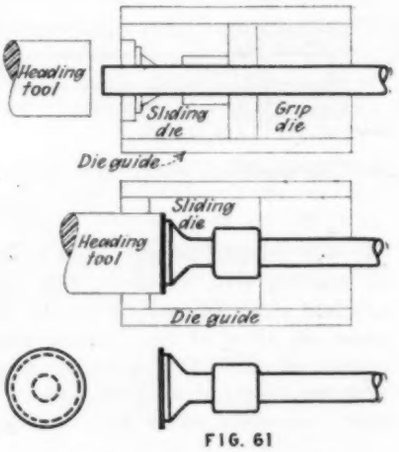


FIG. 61

58—Recess in both dies. 59—Work pinched in dies. 60—Alternating the recess. 61—A good example

can be made, keeping in mind in each case that the diameter of the taper hole near the middle of the unsupported portion of the stock, must be kept within the requirement of Rule II. The taper upset is also valuable in properly distributing the stock at desired points, such as at the base of the final upsets in Figs. 52 and 53, in more easily filling a large flange. The latter shows an unusual form of upset.

Another form of die having great possibilities, but the limits of which are more frequently misunderstood, is the sliding die, as shown in Fig. 54. Rule I, however, still holds, since the total length of unsupported stock, measured from the bottom of the die impressions, as at "*V*," must not exceed three diameters of the bar. In Figs. 55 and 56 are shown the practical applications of this form of die.

In case the length of unsupported stock is more than three diameters, as shown in Fig. 57, then both Rules II and III must be kept in mind as applying to the relative diameter of the upset, as at *W*, and the length of stock extending beyond the face of the die, as at *X*.

There is represented in Fig. 58, a failure in a sliding die. The middle of the stock being beyond the face of the die, and hence unsupported, would buckle, as indicated in Fig. 59. In any extensive application of the sliding die, it is generally necessary to gather stock in several impressions, and here not only must Rules II and III be kept in mind, but also that the friction along the side of the die will cause the upsetting to take place near the front end of the die. For this reason, if the first upset is formed in the rear half of the die then the second impression should be in the front half, etc., in order in each case to bring that portion of the upset which naturally swells the most, into the bottom of the next impression. Fig. 60 shows the idea.

In the application of the sliding die, Fig. 61, an upset is made in the sliding portion of the die, and another at the front face of the die at the same stroke of the machine.

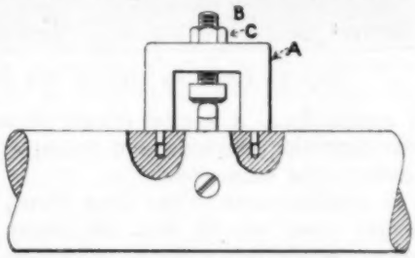
Ideas from Practical Men

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

Gage for Setting Boring-Bar Cutters

BY H. MOORE

Many of the gages used for setting the cutters in boring bars allow errors to be made, because of the impossibility of holding the gage in the same position each time a cutter is set. To overcome this trouble we made our gages as shown in the illustration.



A gage that will duplicate settings

Two small holes were drilled in the boring bar, one before and the other behind the cutter. The feet of the gage were provided with pins to fit in these holes. The gage can be placed in the same position each time it is used, thus insuring a duplicate of the previous setting. We use the gage to reset the tool after each grinding.

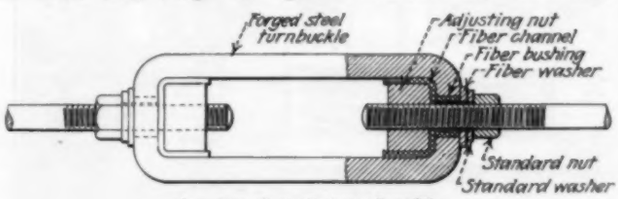
The body *A* of the gage is made from flat stock and is drilled and tapped for a ¼-in. screw at *B*. The lock nut *C* holds the screw in position after it has been set.

An Insulated Turnbuckle

BY DAVID P. MILLER

For safety purposes it is often good practice, and sometimes necessary, to use an insulated turnbuckle. An economical and efficient turnbuckle can easily be made and insulated, as shown in the accompanying illustration.

The turnbuckle is a simple forging with holes drilled in each end, large enough to insert fiber bushings.



An insulated turnbuckle

The adjusting nuts are drilled and tapped to suit the rods. The insulation, consisting of two pieces of fiber channel, two fiber bushings and two fiber washers, can be purchased at a very low cost. The steel washers and check nuts are standard. The adjusting nuts act as jam nuts and also hold the insulation securely in place.

It is not intended that this appliance should be used around high-voltage lines, but where the lines carry low voltage, it is very safe. It can be made in any ordinarily-equipped shop.

Scraping Cast Iron—Discussion

BY E. RECTOR

I wish to take exception to some of the statements made by Francis Julius Dittmar on page 481, Vol. 63, of the *American Machinist* under the title given above.

In the first place he says that "a little reflection will show that to take a chip an inch wide with a scraper, is not only impossible but would be undesirable," etc. Reflection—which in my case means calling to mind some of the things I have seen done and even helped to do—convinces me that not only is it *not* impossible but that it has been done regularly for a good many years. And I have seen more scrapers that were two inches wide than scrapers that were less than one inch. A narrow scraper has its uses, but, like the scraper, they are narrow.

Again he says: "producing a true surface with a scraper means to remove small, not to say minute, quantities of metal, often located close together with deep holes between"; and that "a wide scraper leads nowhere." It would seem to me that a wide *flat* scraper might reasonably be expected to span several of the "holes," and reduce the adjoining hills to something like uniformity, while a narrow one might dig the holes deeper as easily as to reduce the protuberances—it would depend somewhat upon the superficial area of the holes.

Hollow grinding the scraper "leads nowhere," if I may borrow an expression from Mr. Dittmar, the thing that counts is the angle of clearance, and this may be as easily controlled by the manner of holding the tool as by hollow grinding. The angle of rake, which should be negative, is determined by the angle to which the end of the tool is ground.

It would be an excellent workman indeed who could produce a flat surface with a scraper that had been honed on an oilstone "miserably out of true." The first-class scraper hand is as particular about the surface of his oilstone as he is about the edge of his scraper; the one may be said to reflect the other. I can agree with Mr. Dittmar that kerosene is the right lubricant to use upon it.

It is quite the common practice of those who scrape intermittently, to round (flatwise) the ends of their scrapers. Don't do it. A rounded end on a scraper that

IDEAS FROM PRACTICAL MEN

is presented to the work at an angle, causes the tool to dig round-bottomed grooves in it; and the "rounder" the end and the greater the angle, the deeper will be the grooves.

And lastly—as the minister would say—why scrape? Doesn't your planer or grinding machine produce flat surfaces?

Machining Racks in a Planer

BY CLIFFORD H. FRENCH

The job illustrated herewith shows how rack teeth can be cut in quantity on a standard machine.

The racks are cut in the shop of the G. A. Gray Co., for its planers. The work is done in large quantities on one of the maximum service planers, as can be seen in Fig. 1. The rack sections are steel forgings that are first planed all over lengthwise, and then arranged across the planer bed for cutting the teeth.

A gang of six tools is used, the final tool in the gang having approximately the correct shape, so as to leave but little for the finishing tool to remove. The first five tools are set in steps of 0.020 in., so that each tool takes a chip of that depth.

The cutting speed is 25 ft. per min. and the return is at 120 ft. per min. Figures show that the roughing tools travel through about 5,000 ft. of forged steel in planing a table full of racks. The tools are ground between operations, but only to insure that there shall be no breakdown during the planing of a batch of racks, since they are by no means in bad condition when the batch is finished. Planing nearly a mile of steel is a good record for roughing tools, and since they are not all of the same brand of steel, it shows that there are several remarkably good steels now available. In Fig. 2, is shown a close up of the roughing operation.

The finishing operation is done with a single tool ground to the finish shape. The indexing for both the roughing and finishing is done automatically by means of the positive feed employed in the Gray planer. A positive feed is essential in work of this kind, since a mistake would destroy several racks in various stages

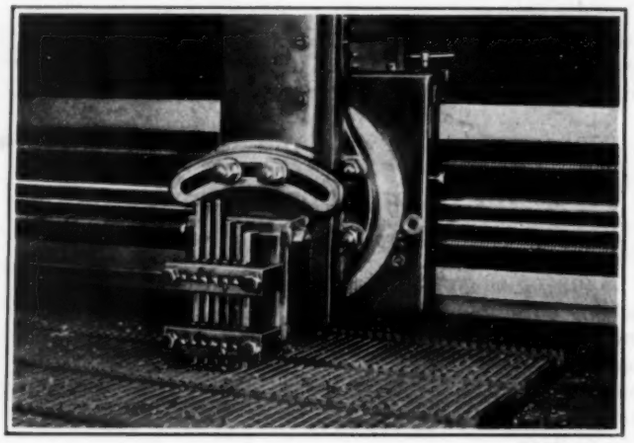


Fig. 2—Close-up view of the gang tools

of completion. A special device on the planer insures that both the roughing and finishing tools start from precisely the same point.

In planing racks in the Gray shops, the former floor-to-floor time was 46 min. per lineal ft., the material being semi-steel. With maximum-service planers equipped with automatic and positive feed, the time has been reduced to 18 min. per lineal ft., in spite of the change of material from semi-steel to forged steel having a high-carbon content.

After the teeth have been cut, the ends of the racks are very accurately planed to insure uniform pitch throughout. Jobs like this and particularly when done in such short time, make us realize that the planer is still in the high-production class among machine tools.

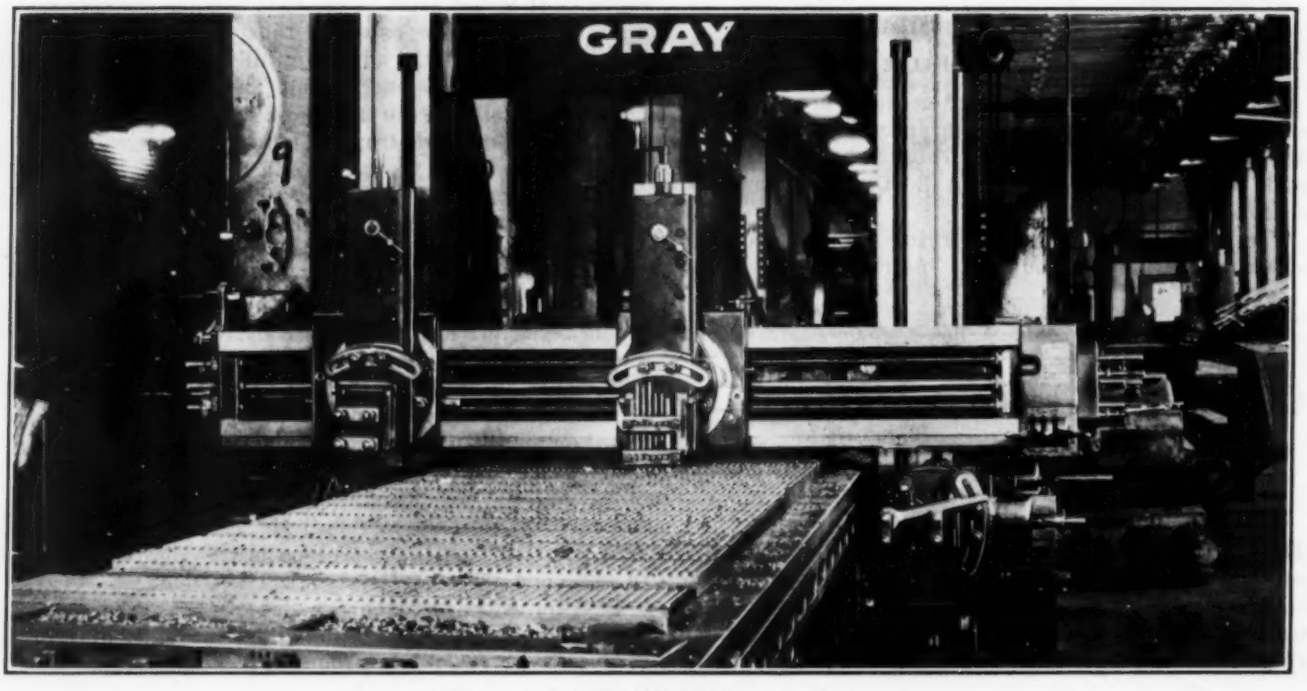


Fig. 1—A table full of planer racks

IDEAS FROM PRACTICAL MEN

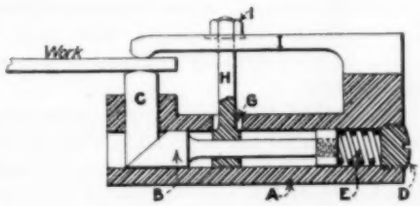
Cam Jack for Light Work—Discussion

By J. C. Harper
Greenock, Scotland

In an article by Gene Phelps, under the title given above, on page 894, Vol. 62, of the *American Machinist*, the author gives a method of supporting light work. As Mr. Phelps himself points out, however, there is a possibility of the cam working loose under pressure of the cut. I suggest the following method as being free from this objection: From the diagram it will be seen that the jack is of the plunger type, but, since it is self-adjusting, it is not open to the objection of springing the work.

The body *A* of the jack may be bolted to the machine table, being provided with projecting lugs to suit. The body is of rectangular section and is machined as shown to fit the ram *B* and plunger *C*. The long axial hole is tapped to take the screw plug *D*. *E* is a spring, the function of which is to move the plunger the required distance. The body is routed out at *G* to allow the eyebolt *H* to be inserted in assembling. *I* is the clamp for holding the work securely.

In operation, it will be obvious that as the spring *E* forces the ram along, the inclined face at its end will contact with the opposing face of the plunger *C*, causing the latter to move upward until it touches the under side of the work. The end of the clamp *I* is then placed directly over the center of the supporting plunger *C*, this being assured by having the heel end of the clamp machined flush with the body. By tightening up the nut *K* it will be seen that the eyebolt *H* is made to serve the double purpose of tightening the ram *B*, thereby preventing any movement of *C* under pressure of the cut, and also of tightening the clamp *I* and so holding the work securely. Various lengths of supporting pins or plungers may be used, as required, to suit the work on hand.



A jack that will not slip

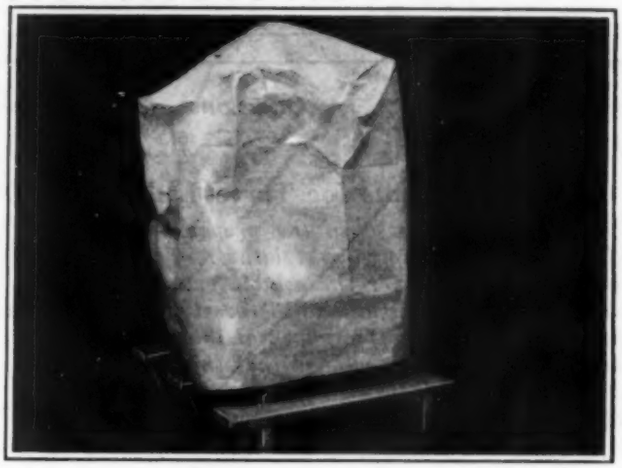
A Machine in a Paper Bag

By Milton Wright

The expression "buying a pig in a poke," which rather more than insinuates that the buyer does not know exactly what kind of a pig he is buying, does not apply to machinery made by one reputable manufacturer, though such machinery may now be purchased in a paper bag.

The illustration shows a paper bag made expressly to cover machinery that is to be shipped a long distance, especially at sea, to protect it from dampness. The material of which the bag is made, is paper that has been subjected to some kind of waterproofing process to render it impervious to moisture.

The bag is made with flaps near the bottom (or top, as it stands in the picture), through which slings may be passed to allow the machine to be lowered into a crate by the crane, after which the flaps are sealed.

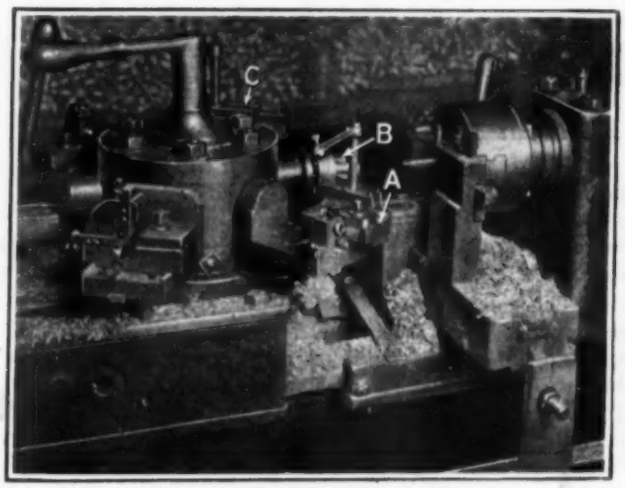


Shipping a machine in a bag

Turret Tooling for Taper Plugs

By Charles F. Henry

The Westinghouse Air Brake Co., Wilmerding, Pa., makes thousands of small plug cocks, so that the making of the taper plugs is a real production job. Special tooling has been devised for use on the small, hand screw-machine shown, and most of the tooling methods can be studied from the single illustration. An unusual feature is the steadyrest on the cross-slide, outside the chuck.



Tooling for taper plugs

The tooling consists of hollow mills, both straight and taper, a single-point tool in the taper slide *A* being used to finish the taper. The spring die *B* cuts the thread on the end, and the plug is cut off by a tool in the cross-operated slide at *C*. The burr at the end of the plug is removed with a file. Given a set-up like this, and a good operator, the output is apt to be astonishingly large.

Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

Cutting Lubricants for Turret-Lathe Work

Q. We are interested in the proper application of soluble cutting oil for turret lathes. There is some question as to whether the soluble cutting oil is the proper material to use, due to the possibility of cutting the ways of the lathe from lack of lubrication. Some shops use lard oil, but we find that this makes a disagreeable odor. We would like to know what is considered best practice in modern machine shops.

A. There is no danger to the ways or working parts of the lathe due to the cutting lubricant coming in contact with them, provided the lubricant is clean and fresh and a reliable product. Companies that are in the business and considered authorities have studied the problem from all sides in an effort to manufacture such a product.

Pure lard oil is very expensive, and more than likely the lubricant you speak of as having a disagreeable odor was a composition of mineral oil and a small per cent of lard oil, which had turned or was already rancid.

There are a good many companies making cutting lubricants, any of which would be satisfactory for your work, but we suggest that you get in touch with the makers of your turret machines who are in the best position to give you recommendations based on what has been found to operate to the best advantage in each particular case from the machine-tool makers' standpoint.

Different Abrasives for Steel and Cast Iron

Q. Is there any difference between the abrasive used for making wheels to grind steel and that correct for cast iron and the softer metals such as brass or bronze and aluminum? If there is please give us some information on the difference.

A. There is a difference. An abrasive which can be recommended for steel and materials of high tensile strength is made from a mineral, bauxite, which is obtained from mines. After being calcined to remove any water it is fused in electric furnaces and results in one of the hardest and sharpest substances known. The fused bauxite or alumina grains are obtained by crushing and screening the solid mass that comes from the electric furnace.

Another abrasive which gives excellent results in cast iron, brass, bronze and aluminum grinding is made by electrically fusing pure silica sand and coke. These two substances, together with a small quantity of sawdust to assist the action in the furnace, are heated sufficiently to drive off the oxygen from the silica to leave silicon which combines with the carbon in the coke to form silicon carbide. This comes from the furnace in a solid mass and must be crushed and screened for use in building the wheels. These wheels are a standard product on the market.

Cone-Clutch Design Formulas

Q. Please tell us the proper formulas to apply in designing a simple cone clutch, and give us briefly the limiting angles and the frictional values of leather on iron and iron on iron.

A. The horsepower which can be transmitted by a simple cone clutch is $HP = fF \times \frac{r}{12} \times \frac{2\pi N}{33{,}000}$

Where f is the coefficient of friction, F is the force normal to the frictional surfaces set up by an axial force holding the parts together and N is the number of revolutions per minute.

From this formula it can be seen that to prevent slipping the force F must be equal to or greater than $\frac{39{,}600\,HP}{2\pi frN}$

The normal force F is obtained by the exertion of an axial force P. This force, P, must be a maximum to initially overcome the friction attendant on bringing the surfaces into contact, but once contact is made it can be considerably reduced and not fail to maintain engagement.

Neglecting the friction of engagement and letting θ be the angle of the semi cone, then $P = F \sin \theta$. Considering the friction of engagement with ϕ the angle of friction then $f = \tan^{-1} \phi$, and $F = Q \sin (\theta + \phi)$.

After the parts are engaged there will be no slip as long as F is greater than $Q \sin (\theta - \phi)$. If ϕ is greater than θ a reverse axial force is required theoretically to break contact.

The width of the cone face is determined by the formula $F = 2\pi rwp$ where w is the width of the face in inches and p is the pressure in pounds per square inch determined by practice. For leather on cast iron good practice is to make p approximately 5 lb. per sq.in. not exceeding 7 to 8 lb. Greater pressures result in excessive wear. For iron to iron, p may be as high as 30 to 40 lb. per sq.in. with good results.

The axial force varies, of course, with the cone angle, decreasing as the angle decreases but causing a corresponding increase in the movement necessary to engage or release and also resulting in an increasing tendency to seize.

Since f for leather to iron is approximately 0.25 and for iron to iron is around 0.15 leather is often used as having the higher frictional value. The angle for the semi cone can vary between 7 and 15 deg. although for leather faced clutches there will be a tendency to stick below 12 deg. or even a little higher. For metal to metal contact the safe low limit can be placed at 10 degrees. Introduction of a lubricant will reduce the coefficient of friction and allow slippage to occur on a clutch designed according to the theoretical formulas without an allowance for the conditions that are to be met in service.

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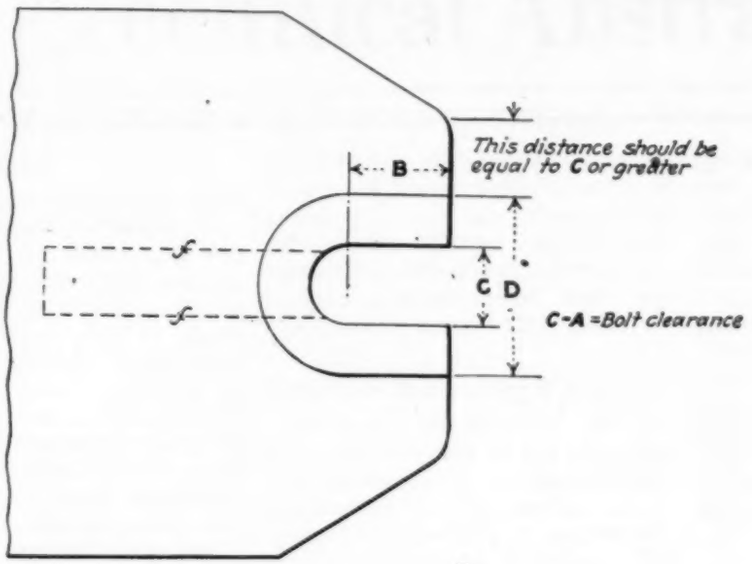
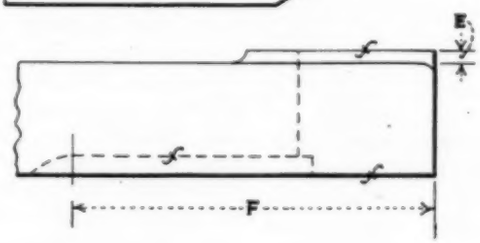
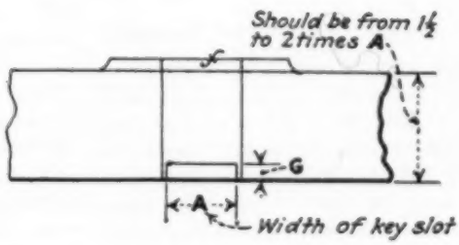
Proportions for U-Lugs for Jigs and Fixtures

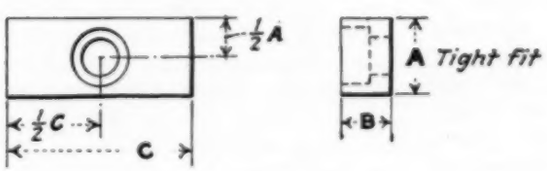






Width of Slot A	B	C	D	E	F	G	Width of Slot A	B	C	D	E	F	G
1/4"	3/8"	5/16"	3/4"	1/16"	1 1/8"	1/16"	5/8"	1"	11/16"	1 1/2"	1/8"	2 3/4"	1/8"
3/8	9/16	7/16	1	3/32	2	3/32	3/4	1 1/8	13/16	1 7/8	1/8	3 1/4	3/16
1/2	3/4	9/16	1 1/4	1/8	2 5/8	1/8	1	1 1/2	1 1/8	2 1/2	1/8	4 1/4	1/4

Size of Keys



A	B	C	Size of Screw	A	B	C	Size of Screw
1/4"	3/16"	3/4"	1/8" x 40 Filister head screw	5/8"	3/8"	1 1/4"	1/4" x 20 Filister head screw
3/8	1/4	1	3/16" x 32 "	3/4	7/16	1 1/2	5/16" x 18 "
1/2	3/8	1 1/8	1/4" x 20 "	1	9/16	2	3/8" x 16 "

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Trim Line

Technical Abstracts

Waste Elimination

Ray M. Hudson states that waste should be continually studied from the view point of eliminating the avoidable portion and of reducing the unavoidable to a minimum. The methods commonly used in waste elimination are broadly classified as follows: first, direct reduction of waste; second, better utilization of by-products; third, greater use of existing facilities; fourth, revision of existing facilities; fifth, simplification and standardization; sixth better control of production resources. These various methods are then detailed considerably. For example, more and more industries are studying their waste heaps and seeking ways and means of utilizing materials formerly regarded as lost. Their efforts toward the better utilization of all these materials may be classified under three principal headings: (a) salvaging; (b) reclamation; (c) by-product manufacturing.

Simplification is well defined as a policy of business management that seeks to conduct all activities and to perform all functions of an enterprise in the least elaborate manner consistent with any given purpose. It is the antithesis of variety and complexity; it means the elimination of the superfluous and the unnecessary. Simplification may be applied to products, parts and processes. Simplification is probably one of the most important means of cutting production and distribution costs, but it cannot be successfully brought about even in a single plant or business without the wholehearted co-operation of the production, the sales and the financial executives.

Standardization is the continuous process of crystallizing the best thought and practice of the industry or the art, and at the same time eliminating that proved to be of lesser quality, utility or value, as uneconomic, wasteful and destructive. It is the logical outgrowth of constructive effort; it is the measure of progress, and the incentive for further advance.

Standards of performance reflect the relative efficiency of machines or men or both. Definite ratios of output to input are necessary in determining whether or not performance is economical, efficient, and profitable.—*Management and Administration*, August 1925, p. 21.

Pyroxylin Refinishing Practice

Research development of the finishing materials of the pyroxylin type as conducted by the company represented by the author, J. J. Riley, finally resulted in the refinishing system that he describes. The basis of the finish now developed is a type of nitrocellulose known as pyroxylin. Its basic material is cotton, specially purified and nitrated. After a process to prepare it for the admixture of solvents and gums, the resultant clear liquid is mixed with finely ground pigments and this produces an opaque pyroxylin enamel that dries by evaporation.

Three methods of stripping the old finish are outlined; these involve the use of paint and sand blasting. Details of finishing and refinishing moldings are clearly outlined.—*Journal of the S.A.E.*, Sept. 1925, p. 245.

Screw Machine Output

This article by L. S. Love states that the production of more than 117,600,000 finished parts is reached each year in the automatic screw machine production department of the National Cash Register Co., Dayton, Ohio, the tolerance allowed being plus 0.0005 in. and minus 0.001 in. The screw products department comprises 432 automatic screw machines, 412 of which are on one floor. The 20 additional machines are in an overflow section on another floor because of the lack of room on the main floor. Screws, pins, counterwheels and other small duplicate parts required in the company's products are made from bar stock on these machines, there being approximately 9,000 different parts.

Work is standardized so that 143 men take care of the operation of the machines and an average day's run is 750,000 pieces, although a recent record day's run was 1,097,000 pieces. The bar stock used in one year totaled 1,432 miles, weighed 4,650,000 lb. and ranged in size from 0.043 in. to 3¼ in. The scrap disposed of amounted to 2,400,000 lb. The machines in this department require seven miles of belting. The accuracy attained is attributed largely to the care and precision used in grinding the tools employed in the machines.—*Iron Age*, Aug. 20, p. 475.

Railroad Scrap

The Pennsylvania railroad, during 1924. accumulated along its entire system over 466,000 net tons of iron and steel scrap of which over 427,000 tons was sold at $6,531,755. The remainder, some 40,000 net tons was reclaimed into a new material value of more than $6,000,000. Its scrap value would have been only a little over $600,000. In the same year the road sold nearly 700,000 net tons of non-ferrous metal scrap for a total of over $900,000. Salvaging makes inroads on orders for new material. In one year, the material reclaimed at the Trenton, N. J. docks included 241,000 lb. of miscellaneous car castings and forgings, 22,000 brake shoes of all kinds, 2,847 brake beams, 49 smoke-box doors and 63 standard log chains. The same year 181,480 lb. of lead were reclaimed. All of the buildings at the scrap dock at Trenton are built from reclaimed material, and the scrap is bought locally for many purposes. For example, the Greek Catholic Church at Trenton recently built around its cementery a fence made of scrap boiler tubes from locomotives on the Pennsylvania system.

The scrap dock is equipped with a blacksmith forge, a nut tapping machine, pipe-threading machine, small air hammer, drill press, acetylene cutting and welding apparatus, clamps, vises and other units. A locomotive crane with a magnet is employed for unloading and loading scrap.—*Iron Trade Review*, Sept. 10, p. 617.

American Machinist

Established 1877

KENNETH H. CONDIT AND FRED H. COLVIN, *Editors*

A Labor Shortage?

A SURVEY of the machinery building companies, and particularly those making machine tools, indicates that a majority of them are wondering where to get good men for their shops. As a result, deliveries several months ahead are being quoted to customers who are anxious for immediate deliveries.

It is the same old story. The blame has to be divided between the buyers who won't pay enough for machine tools to enable the builders to keep valuable men occupied during dull times, and the builders who aren't courageous enough to demand such prices from customers who are perfectly well able to pay them.

The situation is complicated by the relatively low wages paid to skilled machinists and the resultant drift away from the shop of good men who find that they can make better livings in other lines, and with less effort.

What is the answer? Well, part of it is higher wages for skilled mechanics and higher prices for machine equipment, both of which call for a willingness on the part of the customer to be satisfied with less than a one hundred per cent return on his investment in machinery. In other words to buy a machine occasionally that will take more than a year to pay for itself.

What Simplification Means

UNLESS one is familiar with the details of a business involving many shapes, sizes and grades, it is almost impossible for him to appreciate the huge number of items that must be carried in stock in order to supply the demands of the trade. And unless one knows something of these figures, it is difficult to appreciate the importance of the work being fostered by the Division of Simplified Practice of the Department of Commerce.

An excellent example of the value of this work is the result of the recent conference in Washington, of the manufacturers, distributors and users of grinding wheels. The simplification was inaugurated by the manufacturers of grinding wheels themselves, and at the conference the representatives of distributors and users confirmed their judgment by adopting the smaller list which had been previously suggested by the wheel manufacturers.

A few figures showing the reduction made will be of interest. The number of shapes of wheels for internal work was reduced from 289 to 95, and the total number of shapes from 414 to 144. These reductions make it possible for the number of stock sizes of grinding wheels to be manufactured and carried by distributors to be reduced from 715,200 to 255,800.

When we consider the amount of capital tied up in these stocks of wheels, by the makers, the distributors and the users, the economic advantage of the work of simplification becomes more apparent.

Fostering Air Transportation

IN THE opinion of Secretary Hoover the time has come for the Government to aid air transportation in the same way that it has assisted commercial navigation for over a century.

The Federal Government provides for the marking of channels for marine navigation, for study of these channels and of charts for them, as well as weather reports for the use of vessels. It also examines officers to maintain standards of skill and experience, and it aids in developing ports and waterways, and has laws covering the many phases of marine navigation.

The cost of providing these aids to aerial transport will be much less than that now expended for waterways. Airways require no developing and can be lighted at low cost. Air lanes can be studied and charted at far less expense than waterways. And it is particularly necessary that both pilots and planes should be under government supervision.

The Winslow Bill, which has been favorably reported by the House Committee, covers many of these points and is a step in the right direction. It should be passed.

Just Suppose

JUST suppose that a man who made his living manufacturing typewriters decided that it was all wrong to build only one size of machine. That his heart was so soft over the troubles of the typist whose hands were too small for the standard keyboard, and for her whose hands were too large, that his head was also softened to the extent that he started out to build a line of machines so complete in its size range that every key tickler could have one exactly to her liking.

Sounds far-fetched, does it? Well, just see how easy it is to think of some builders of other kinds of machinery, machine tools for instance, who are guilty of much the same kind of reasoning, and are consequently contributing to the staggering burden of waste that industry is carrying.

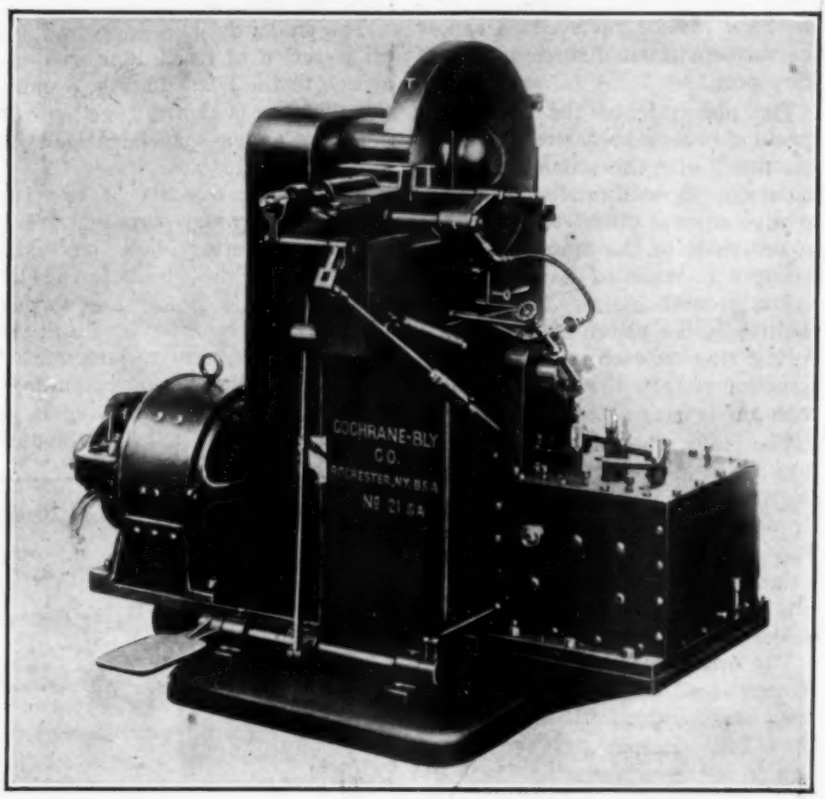
Wouldn't it be easier for all hands if nobody indulged in such wasteful foolishness?

Just suppose.

Shop Equipment News

Cochrane-Bly Automatic Cut-off Saw No. 21-SA

The automatic cut-off saw illustrated is being built by the Cochrane-Bly Co., Rochester, N. Y. It has been designed primarily for cutting bars, tubes, extruded sections of non-ferrous metals and similar work, but it can also be used for cutting wood, fiber, hard rubber, bakelite and other non-metallic materials. Also, by mounting an abrasive disk in the place of the saw, it can be used on magnet steel, hardened drill rod, tool-bits, porcelain and materials that the saw blade cannot touch.



Cochrane-Bly Automatic Cut-Off Saw, No. 21-SA

The vise for holding the work is operated automatically in time with the carriage movement and will hold work measuring up to 4 in. in diameter. The movement of the jaw is a maximum at ¼ in. It can be reduced as desired from that point.

The carriage is adjustable with relation to the vise to compensate for wear of the blades and to vary the position of the work in the vise. It has an adjustable travel which can be varied between ½ and 4½ in., and a speed range from 1 to 30 strokes per min., in 18 steps. The spindle runs in Timken roller bearings which are mounted in dust-proof cases.

An automatic, positive clutch is provided, and is designed to be actuated by means of a foot treadle. As long as this treadle is depressed, the machine will run, but after it is released, the machine will make one stroke and will then stop with the blade in the back position. The operating cams can be changed to give speeds up to 120 strokes per minute. For special jobs, automatic feeds can be provided to buyers' specification.

Lubrication at the work is provided under pressure by a pump which delivers to a nozzle through a length of flexible tubing. A jet of lubricant is delivered on both sides of the blade close to the collars, and centrifugal force distributes it to cool the entire blade and to flood the teeth. A reservoir is provided for the return.

The machine, when arranged for belt drive, occupies a floor space of 48x50 in., and weighs approximately 2,150 pounds.

Worthington "Feather-Valve" Vertical Air Compressors

The vertical feather-valve compressors are being built by the Worthington Pump and Machinery Corporation, 115 Broadway, New York, N. Y., for use in garages, repair shops and small industrial establishments. They are being furnished to the market in two types, the water-cooled design illustrated in Fig. 1 and an air-cooled machine.

The air-cooled compressor is made in two sizes, 2½ x 3 in. and 3½ x 4 in. and is especially adaptable for tire inflation.

The water-cooled type is made in 4 sizes up to a maximum of 6½ x 5 in. and is intended for tire inflation,

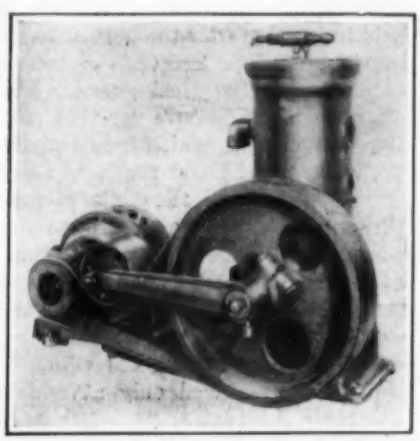


Fig. 1 — Worthington "Feather-Valve" Vertical Water-Cooled Air Compressor

SHOP EQUIPMENT NEWS

operating pneumatic jacks, cleaning by air blast, for lifts, hoists, drills, hammers and other tool operations and for the brazing forge and similar work.

Pressure forced-feed lubrication and accurate balance of the reciprocating parts are features of the machines together with the design of the feather valves.

These feather valves are similar to those used in the larger types of the company's line of compressors. The

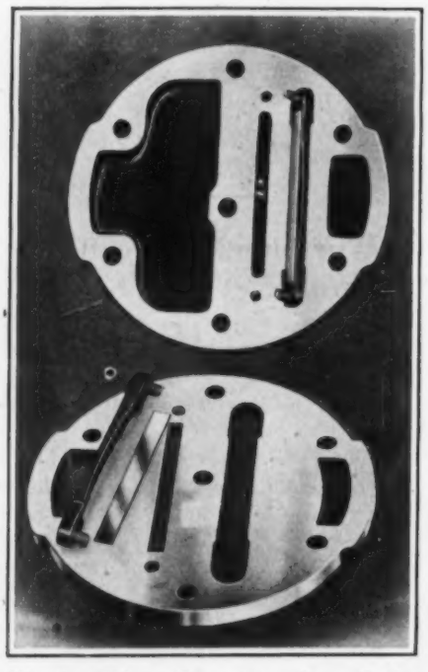


Fig. 2—The valves, guards and the ports they cover

valve proper consists of a strip of light ribbon steel made somewhat larger than the part over which it rests in a flat position. The strip is held in location over the port as to its overlapping sides and ends by means of a drop-forged steel guard. The guard is made concave for that portion of its length which is just above the valve so the latter can bend away from its seat and allow air to pass through the port and around its edges. This construction has eliminated the impact between valve and seat which was encountered in the old type of plunger valve and has reduced the cost of removal which is said to be required only at widely separated intervals.

The suction and discharge valves are identical, one with its guard being secured to the bottom of the cylinder head over the intake port and the other being placed on top of a port through a valve plate that communicates to the delivery line. The two ports with the valve parts ready to screw in place are shown in Fig. 2 with the intake port above the valve plate which contains the delivery port.

An automatic unloader can be used on top of the cylinder head to operate a plunger that will hold the intake valve away from its seat for receiver pressure above a certain point or a hand-operated plunger can be substituted as desired. So long as this valve is held away the machine will not deliver to the receiver. Since delivery and intake are from the side the head can be removed to expose the valves without disturbing any of the piping.

The piston is of the automobile type and is accurately ground to size and fitted with three hammered piston rings. Special provision is made to wipe surplus oil off the walls and to return it to the crankcase. The wristpin is made of hardened steel and is ground to size. It is held in position in the piston by means of a spring ring on each end. This construction enables the pin to be made with ample bearing area.

The main removable babbitt bearings are of the two-part die-cast type and are arranged so they can be readily adjusted, removed and replaced. The crankshaft and its counterweights are drop forged from a single piece. The connecting rod is also drop forged in an I-beam section.

The machine illustrated in Fig. 1 is arranged for a close-up motor drive and has included in its assembly a belt tightener arranged on an arm from the crankshaft. Tight and loose pulley construction can also be specified.

Standard equipment includes, on the water-cooled machine, a flat cover for a closed cooling system or an open water jacket for open overflow or for a hopper cooling system; a tight pulley on the crankshaft and a complete hand-operated unloader. Other parts are subject to specification such as the automatic equipment for unloading, the pulley arrangement for the closing belt drive, the compressor base, the initial start and stop electric control, mufflers for intake and discharge lines and the motor and its controls.

Morris Hand Overhead Runway System

A hand-operated overhead runway system is being built by Herbert Morris, Inc., Buffalo, N. Y., that includes load-carrying trolleys of various capacities and switch sections, curves and runs of overhead track.

The principal features of the system are in the design and construction of the trolleys and the switches, the latter having no moving parts and selection of direction, straight or deviating through a switch point, being accomplished by manipulation of a direction control on each load-carrying unit.

The trolley is illustrated in Fig. 1 on a section of track, approaching a switch to the left. In Fig. 2 one of the switches is shown, together with a trolley and a suspended load just beyond it.

The trolley consists of two two-wheel units which support a horizontal connecting link on pivots located below the wheels to clear the track and on a center line through the pairs of wheel shafts. Each two-wheel unit can be turned horizontally about its pivot when rounding a curve or leaving a straight run through a switch. Springs mounted

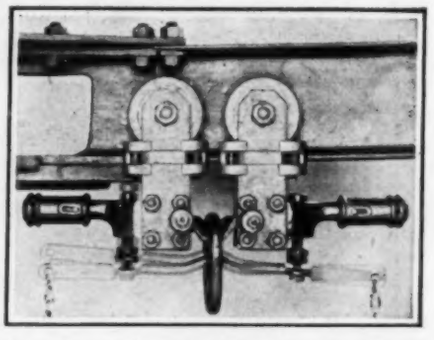


Fig. 1—Morris Trolley for Overhead Runway System

on the sides of each unit press against the connecting link to hold the units normally in line.

A steering member is secured to each unit and projects to the front and back of the trolley to terminate in spring protected bumpers. A pin and roller set vertically in each steering member can be alternately raised or lowered by means of a horizontal link connection to each end of which control chains are attached to be operated from the floor.

SHOP EQUIPMENT NEWS

When a trolley approaches a switch point the chain at the rear is pulled to raise the forward pin, providing it is desired to switch off to the branch. This pin engages in the slot formed

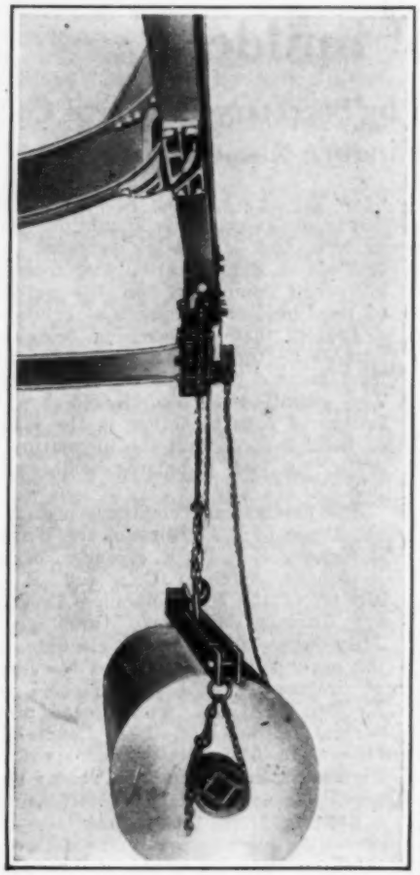


Fig. 2—A switch in a line of track

by the switch castings and turns the forward wheel unit to follow the branch track and to take the rear wheel unit with it. Rollers are set vertically at the four corners of each two-wheel unit to ride against the lower flange of the track to reduce the friction on rounding a curve. The wheels ride on roller bearings and are flangeless, the function of flanges being taken care of by the vertical rollers. The construction is said to materially promote smoothness of action.

The track is constructed of I-beams of proper size for a given installation. The switch parts that are bolted rigidly to the beams are made of castings. The trolleys are made in six sizes of rated capacities in tons of 2,240 lb. The sizes are for ¼, ½, 1, 1½, 2 and 3 tons.

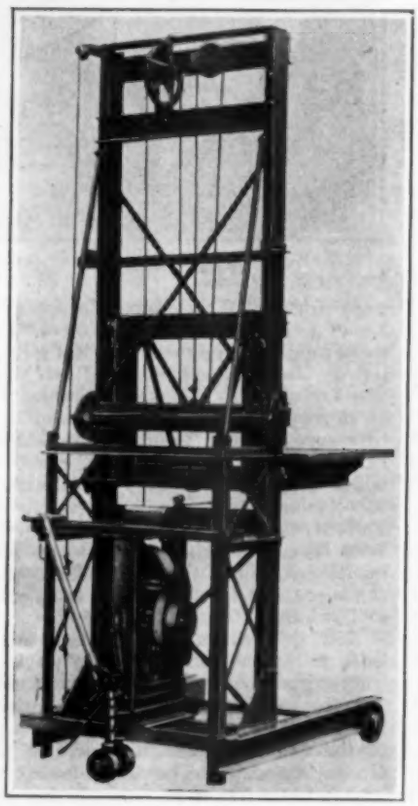
Special attachments for handling various materials can be specified.

Lewis-Shepard Heavy-Duty Power Stacker, Type PB

The Lewis-Shepard Co., Watertown Station, Boston, Mass., has added the heavy-duty power stacker to its line of material-handling equipment. The type PB illustrated is intended to increase the range covered by the hand-operated type HB and the light-duty electric stacker, type CB, previously described on page 792, Vol. 62 of tha *American Machinist*, both as to speed and as to capacity.

The type-PB machine is being built in two sizes to handle 1,000-lb. and 2,000-lb. loads respectively. It is powered with a 2½-hp., high-torque elevator-type motor, and has a lifting speed of 40 ft. per min. with a 1,000-lb. burden.

It is designed on the worm-drive principle, the worm running in a bath of oil. There are no exposed gears. The operation, both up and down, is through a controller. In operation, the brake is normally set so there will be no movement or opportunity to drop a load. The operator releases this brake to move the platform in either direction.



Lewis-Shepard Heavy-Duty Power Stacker, Type PB

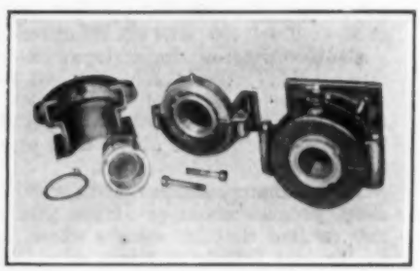
The floor wheels and sheave wheel are equipped with Hyatt roller bearings. As in the case of the other two stackers, the upright framework is hinged so the machine can be transported through ordinary doorways and then straightened up to make use of its maximum height capacity. The machine is intended for many uses, such as changing dies at presses, filling vats easily by placing the supply drums on the platform and then raising them, piling and unpiling bales, crates, boxes and many other items such as lending assistance to overhead installation and millwright work and for use as an elevator between floors.

Bantam Self-Aligning Ball Bearing

The Bantam Ball Bearing Co., Bantam, Conn., has developed a self-aligning ball bearing for line and countershafts, which it is now placing on the market.

The illustration shows two bearings, one assembled and the other taken apart to show its components. The periphery of the outer race is made convex to match the correspondingly concave seat of the housing in which it floats. It is claimed that a shaft with a pronounced permanent bend will run in this bearing without binding or excessive friction.

The housing is in two parts to permit assembling, and is designed to go into any standard yoke hanger.



Bantam Self-Aligning Ball Bearing

It is fitted with connection for an Alemite gun to supply oil or grease.

The bearing is now made in three sizes to cover a range of shaft diameters from 1 to 3 7/16 inches. Split bushings adapt the bore of the inner race to any standard shaft diameter.

News of the Week

Lucas Heads Machine Tool Builders

Twenty-fourth annual meeting at Washington addressed by Secretary Hoover – Code of ethics unanimously adopted–Confer with Ordnance Association

The feature of the twenty-fourth annual meeting of the National Machine Tool Builders' Association, held in Washington on Sept. 30 and Oct. 1 and 2, was an address by Secretary of Commerce Herbert Hoover. As an opportunity to get better acquainted with the work of the Department of Commerce, the avowed intent of the meeting, the convention was a success. After two days in Washington the delegates joined the members of the Army Ordnance Association, the Franklin Institute and several of the engineering societies in witnessing a demonstration of ordnance material at the Aberdeen Proving Ground.

The sessions on the first day were held in the building of the Chamber of Commerce of the United States to which the delegates were welcomed by resident vice-president Goodwin, of the Chamber. W. A. Viall, of the Brown & Sharpe Manufacturing Co., as chairman of the committee on fellowship, pointed out the value of this feature of the association meetings and offered the services of his committee to further better acquaintance among the members.

Iles Scores Poor Ethics

President O. B. Iles, of the International Machine Tool Co., then gave his presidential address in which he said some very uncomplimentary things about the lack of sportsmanship of business men that stoop to unethical methods. He suggested that an experience meeting attended by salesmen and sales managers might be embarrassing to some but would be very enlightening.

Commenting on the state of the industry Mr. Iles said that the last few months have been encouraging ones in the volume of business transacted, and that the months just ahead hold promise for even better business.

In his annual address, Ernest F. Du Brul, general manager of the association, stated that his figures show that the present volume of business is about equal to that of the spring of 1923 and that the fall months will probably see higher levels. He said that some economists believe the present activity of business to be based on the big building program. It is also thought the building industry is dangerously inflated. Many machine tool orders have depended on the automotive industry which is showing unexpected strength, but which has an element of weakness in the large number of cars sold on credit. Any recession in general business will have a serious effect on the automobile business for this reason, an effect that will be reflected in machine tool sales. There has been some wild speculation in the stock market but there is nothing to show that credit has as yet been inflated.

Mr. Du Brul asked for better statistics from the members of the association, for standard nomenclature, for some action to standardize tool- and work-holding elements, for simplification in the number of sizes of machines and for research. Needless duplication of effort is occurring by reason of lack of co-operation in internal standardization and individual research, much of which could be avoided by establishing association programs in both fields. The success of the recent Cleveland and New Haven machine tool exhibits was mentioned, but it was pointed out that the success of all shows does not necessarily follow.

H. M. Lucas

Now is the time for trade associations to do the most effective work in improving business conditions and raising the quality of business practices, according to J. H. McCullough, head of the division of manufactures of the U. S. Chamber. The individualist no longer fits into the picture. Today one must play the game according to the rules or make way for those who will. Mr. McCullough said that because so many businesses are not sure where to draw the line between profit and loss, the trade associations should institute uniform cost accounting systems. He touched on simplification and research and then commented on the activity of the Chamber in industrial relations, a subject that is becoming more important as the restrictive immigration laws become more and more effective. The situation is complicated by the failure of sons to follow in the trades of their fathers, and the inclination to drift into less promising white-collar jobs.

The nominating committee presented the names of P. E. Bliss, of the Warner & Swasey Co.; H. K. Spencer, of the Blanchard Machine Co.; and E. A. Muller, of the King Machine Tool Co. for directors to serve three years. They were unanimously elected. At the organization meeting of the board of directors H. M. Lucas, of the Lucas Machine Tool Co., was elected president; J. G. Benedict, of the Landis Machine Co., first vice-president; H. L. Flather, of the Flather Co., second vice-president; and E. A. Muller, treasurer.

Reports from the various standing committees brought out the following recommendations: That all members write their advertising to include in some way the five slogans suggested for five respective two-month periods. That repair parts for discontinued machines be promptly available, except for machine frames and other heavy parts, for a period of five years after manufacture ceases. That usual repair parts be available but not necessarily promptly for an additional five-year period. That no repair parts be kept after a ten-year period has elapsed. That prices for repair parts be based on cost plus a liberal profit.

Code of Ethics Adopted

The extremely comprehensive code of ethics which has been under consideration for three years was unanimously adopted and with it a provision for the appointment of a permanent committee of five to administer its provisions.

Appropriate resolutions on the deaths of B. M. W. Hanson and A. J. Jones were adopted.

At the afternoon session Major R. H. Somers, Ordnance Department, U. S. A., read a paper on "Machine Tools and the Munitions Program," in which he elaborated on the more general address by Assistant Secretary of War Davis which was published in full in the *American Machinist* some months ago.

The second day of the meeting was devoted to the Department of Commerce. At the morning session, in the Commerce building, Dr. Julius Klein, director of the Bureau of Foreign and Domestic Commerce, was the first speaker. Mr. Hoover was to have opened the meeting but was delayed by an unexpected meeting of the French debt funding committee.

Dr. Klein who has just returned from a European visit told of the feeling of nationalism that has sprung up since the war with its accompaniment of stiffened barriers between jealous neighboring countries, and endeavor to foster and protect new industries called into being by the war. The result is an increased demand for American production machinery which will increase as the countries prosper and are better able to buy. American production tools with their guaranteed service are holding their own against foreign competitors in spite of their greater cost.

As an indication of the growth of his bureau, Dr. Klein stated that the number of services rendered has risen from 505,000 in 1922 to 2,041,000 for the last fiscal year. The rate of growth has been 75 per cent a year as against an increase in appropriations of only 7 per cent. No European government is offering a service that can compare with our own.

A series of four ten-minute talks were given by representatives of the Commercial Intelligence, Regional, Foreign Tariffs and Commercial Laws divisions each speaker outlining the work of his division. Then came a short talk by E. E. Hunt, assistant to Secretary Hoover, who reviewed the work of the Unemployment Conference, the Survey of Current Business, and the Division of Simplified Practice.

When Secretary Hoover arrived, he told the gathering of the desire of the government to aid business without engaging in it and stated his belief in the trade association as an indication of the healthy desire of an industry to advance itself. He gave it as his opinion that our future hold on export trade will depend on our ability to manufacture standard quality articles by mass production methods that will be successful against cheap labor.

Speaking on the patent situation the Secretary expressed his hope that all arrears would be disposed of by the beginning of 1926. If our delegates at the Hague conference are not successful in reaching some agreement that will put our patent laws on a reciprocal basis with those of other countries it will be necessary to ask for legislation here.

In a plea for more and better information on business he said that statistics form the raw material for judgment by business men. With adequate statistics, we can do much to wipe out the worst blot on our economic system, the boom and slump.

In the afternoon the delegates went out to the Bureau of Standards where they were welcomed by Director Burgess and then broke up into groups to visit the different points of interest in the various buildings.

The third day of the meeting was devoted to a visit to the Aberdeen Proving Ground where demonstrations of all sorts of ordnance material were witnessed in connection with the annual meeting of the Army Ordnance Association described below.

Army Ordnance Association Witnesses Impressive Demonstrations

Target practice of anti-aircraft guns creates interest

The seventh annual meeting of the Army Ordnance Association at Aberdeen Proving Ground, Maryland, on Oct. 2, brought out a record attendance. Other organizations participating in the affair were the National Machine Tool Builders' Association, the Franklin Institute and the National Aeronautic Association. Something over 2,000 members of these organizations and army officers were present, a record for these meetings.

At a gathering shortly after luncheon addresses were made by Majority Leader John Q. Tilson of the House of Representatives; Benedict Crowell, president of the A. O. A.; Dr. Wm. C. L. Eglin, president, Franklin Institute; Major General Summerall, commander of the 2nd Corps Area; and Major General C. C. Williams, Chief of Ordnance. Mr. Tilson expressed his hearty sympathy with the cause of industrial preparedness as an effective war preventive and assured those present that their cause would always have his active support in Congress.

Among the most spectacular of the many demonstrations staged by the army were the firings against a sleeve target towed by an airplane, with 3-in. anti-aircraft guns by Battery C, 62nd Coast Artillery. It was reported later that 29 shrapnel bullets had been sent through the target at a height of over 3,000 feet.

Another thrilling spectacle was a field maneuver by a battery of the 6th Field Artillery. The battery rode into position, unlimbered, registered on a target with shrapnel and then laid down a smoke barrage.

A double parachute drop from a Martin bomber was staged by the Army Air Service, one man jumping from the plane and opening his parachute after falling a short distance while the other opened his parachute first and was pulled by it from his position on the wing. The dropping of demolition bombs and the laying down of smoke curtains by bomb dropping and by chemical ejection were also demonstrated.

Tanks of various sizes were put through their paces, as were all sorts of tractors and other mobile artillery and ordnance units. Machine guns were fired against tank plate and, with tracer ammunition, against free balloons. At the other extreme were firings of the 14-in. and 16-in. seacoast guns. A photograph was taken of the visitors grouped about the latest type railway mount.

The mobile public address system of the Signal Corps added much to the success of the meeting. Speaking in an ordinary tone of voice the announcer was thus able to make himself heard with ease by every one of the more than 2,000 guests.

The 1st Ordnance Company from Miller Field, L. I., was on hand with its equipment of mobile ordnance repair shops. Naturally, the machine tool builders found much of interest here. Photographs of some of the units are reproduced in the picture section elsewhere in this issue.

Fall Meeting of Welding Society

Plans have practically been completed for the annual fall meeting of the American Welding Society, which will be held at the Massachusetts Institute of Technology, Boston, Mass., Oct. 21, 22 and 23. Headquarters for the technical sessions and business meetings will be in the Institute, while the social functions will be held in the Hotel Somerset.

An interesting program of papers covering a wide range of welding subjects has been prepared by the committee in charge. Some of the subjects, with their authors are:

"Thermit Welding," by J. H. Deppeler, chief engineer of the Metal and Thermit Corporation; "Gas Welding and Power Plant Piping," by A. W. Moulder, chief engineer of the Grinnell Co.; "Industrial Applications of Arc Welding and Economies Effected Through Its Use," by H. M. Hobart, chairman of the electric arc welding committee, and W. Spraragen, secretary; "Selection of Materials for Welding," an open discussion which will take the form of a series of short addresses by several prominent experts on this subject; "Manufacture of All Steel Automobile Bodies," by J. W. Meadowcroft, general supervisor of welding, the E. G. Budd Manufacturing Co. This address will be illustrated by motion pictures.

All during the three days of the meeting there will be exhibitions of welding equipment in action.

New York Section of S. A. E. to Meet

The first fall meeting of the metropolitan section of the Society of Automotive Engineers will be held on Oct. 15 in the Hotel Majestic, New York. The program includes dinner at six o'clock, followed by a discussion on the subject "Speeding Up Traffic, Safely." Three speakers have been invited to take up the various angles of the discussion. They are: John C. Long, secretary of the traffic planning committee of the National Automobile Chamber of Commerce; Harold M. Lewis, executive engineer, Russell Sage Foundation; and Major Elihu Church, transportation engineer, Port of New York Authority.

Gear Manufacturers Discuss Improvements Needed in Automotive Steels

Standardization work goes on at West Baden—Papers of good quality read—Next meeting to be held in Detroit

The work of standardization has always had the place of greatest prominence in affairs of the American Gear Manufacturers' Association and will occupy that position for some time to come. As the work of standardization progresses, however, other problems come to the front.

A new note was sounded at the Fall meeting held in the West Baden Springs Hotel, West Baden, Ind., Oct., 1, 2 and 3, when W. G. Hildorf, consulting metallurgist of the Reo Motor Car Co., presented a paper, "Improvements Needed in Automotive Steels."

Because of the importance of gears in the automobile, and of steel to the manufacturer of gears, the subject of improvements needed was discussed extensively and the members of the association indicated clearly their desire for further work in that direction. The subject will apparently remain well to the front for some time.

Enthusiasm in Program

Perhaps because of the difficulties in the way of getting to West Baden and probably because less than five months had elapsed since the ninth annual meeting in Pittsburgh, the attendance was small in comparison to that of other metings. Nevertheless, the program was carried through with the characteristic A.G.M.A. enthusiasm.

The small attendance of the Fall meeting may be taken as an indication that the tenth annual meeting, to be held during May, 1926, at Detroit, will be very well attended. Further evidence of large registration next Spring is the increase of membership as the result of elections at West Baden.

The new member-companies are:

Lewis Foundry and Machine Co., Pittsburgh, John Lucas, executive representative.

Ferguson Gear Co., Gastonia, N. C., Richard Ferguson, executive representative.

Alford Wiseman, Ltd., Birmingham, Eng., J. Wilfred Harris, executive representative.

Timing Gear Corporation, Chicago, R. O. Bauman, executive representative.

John Lundberg was elected an additional associate member from the Tool Steel Gear and Pinion Co., of Cincinnati.

The golf tournament, for which the *American Machinist* had provided a cup, was postponed on account of lack of time and inclement weather. The play-off will take place at the next meeting.

Proposed recommended practices offered by three committees were accepted. They were:

Recommended practice for the inspection of gear cutters (disk), by the inspection committee.

Recommended practice for interchangeable gears, by the modified 14½-deg. incolute curve system, by the tooth form committee.

Recommended practice for steel castings for gears, by the metallurgical committee.

These three recommended practices will be printed in the *American Machinist*.

The reports from other committees dealt with progress. Much of the work reported will result in recommended practice suggestions and later in accepted standards.

Standardization Report

Of unusual interest, in that it outlines one of the objects of the A.G.M.A., is the following extract from the report of the commercial standardization committee:

"The high points in an excellent address by Mr. Graham, president, Bolt, Nut and Rivet Manufacturers' Association, modified to cover our industry, are as follows:

"The gear industry has become specialized so that it cannot be operated as a side line. A large steel works, for instance, installed gear cutters and the records show apparent profits, as no overhead is included in cost. But operations are evidently at a loss because the cutting speed is only one-third of that used by gear manufacturers.

"A manufacturer of rolling mill machinery was selling gears under the market, he figuring practically no overhead and but little labor, because his automatic machines were operated by men whose time was charged to other operations in the plant.

"If we can convince those who are cutting their own gears that it will be to their advantage to let us supply them, and for them to confine their energies to their own products, we can operate our plants on a normal basis.

"Evils that have crept in through operating as *individuals*, must be eliminated by development of the *industry* as a whole by uniform cost accounting, standardization, elimination of waste, and so on.

"Every plant should be operated as economically as possible, which can be only if plants are thrown open to competitors so that all may benefit by the example of the low-cost producer. The great saving attained should be handed down to the ultimate consumer.

"By fair dealing, honesty of purpose, and co-operation, our industry may be made something of which we will be justly proud."

The association now has available, through the committee on non-metallic gearing:

Tables listing the horsepower of non-metallic spur gears composed of laminated phenolic materials or rawhide. These tables cover gears of 1-in. width of face and diametral pitches of 1, 1½, 1¾, 2, 2½, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 18 and 50.

Tables showing the results of impact, compression, transverse and deflection tests on six materials.

A formula for computing the horsepower of non-metallic spur gears composed of laminated phenolic materials or rawhide. Accompanying the formula are tables showing the value of S (safe working stress of material) and Y (constant depending upon the number of teeth). A value of 6,000 lb. was used as the safe woking stress for static load and the formula $\frac{600}{600 + plv}$ was used in computing the values of S. The values of Y are the same as used in the Lewis formula.

The transmission division of the differential and transmission committee presented, for criticism and discussion, a nomenclature for certain parts of a conventional three-speed transmission. It is hoped that, as a result of suggestions that will be made, a proposed recommended practice can be offered at the next meeting.

The report of the A.G.M.A. sectional committee of the A.E.S.C. announced that the next meeting will be held during October, to consider especially nomenclature and tooth form.

Lewis Machine Is in Use

E. W. Miller, of the Fellows Gear Shaper Co., reporting for the A.G.M.A. research committee on gears, stated that the Lewis testing machine, now at the Massachusetts Institute of Technology, has been proved to be responsive to the requirements made of it; that the character of the research work requires care in checking; and that great attention has been given to details, which explains the seeming slowness of obtaining results.

E. J. Frost, president of the Frost Gear and Forge Co., of Jackson, Mich., and president of the association, presided at all of the regular sessions. In opening the meeting, Mr. Frost outlined some of the work that may be expected from the association. He said, in part:

"Let me remind you that it is only nine and one-half years since the American Gear Manufacturer's Association had its birth at Lakewood, New Jersey, and in the comparatively short time that has elapsed we have grown from a mere toddler to an organization embracing in its membership practically every worthwhile manufacturer of cut gears in the United States and some in foreign lands. We have emerged from the obscurity naturally surrounding a new venture until today we have practically the entire mechanical world

watching us and yielding recognized leadership in the establishment of standards pertaining directly to our industry and to a myriad of occupations more or less related through the use of the product of our craft.

"At the best, standardization work is slow, as many minds must meet and agree and when you consider that we labor, not by and for ourselves but in conjunction with other engineering bodies, in the hope and with the expectation that what we do will not only become our standards or United States standards but shall be, if possible, of world-wide acceptance, our labors and the very slowness with which we move find justification. I beg of you, therefore, not to be discouraged in your committee work, but to accept, as a personal challenge, the toil and self-sacrifice of the chairman of the general standardization committee.

Commercial Standardization

"While it is true that up to now we have given considerable time and thought and occasionally had a paper and discussion on the subject of commercial standardization, it nevertheless is equally true that the results have been disappointing. I wish to make it perfectly clear that in no way do I attribute this to failure on the part of the committee intrusted with this particular phase of our work, but to a seeming indifference or at least reluctance on the part of most of the member companies to depart from established practice. In view of the exigencies of the case, and encouraged by the changed attitude of the government, it certainly seems wise and desirable for us to see if something constructive, cannot only be worked out, but given by all of us a conscientous and faithful tryout in the hope of arriving at saner and more consistent prices than have characterized our actions in the past.

"Since our last meeting I have had some correspondence with the United States Chamber of Commerce and with various government officials with a view to our tendering the services of our association in matters of material and design, to the end that when we receive drawings on which we will be expected to quote, the articles can be made on standard equipment, with a toolup of normal cost and with limits obtainable. During the war there were many things brought to our attention that would have been laughable were the situation not almost pathetic. I quote one single instance out of many. We had drawings submitted to us, as did other members of this association, involving bevel gears where no great refinement was needed, but the angular dimensions were three hundred times finer than you can set a Gleason generator. Even if these could have been produced as called for I am at a loss to think how they could have been inspected, unless, perhaps, some astronomical shop could have been requisitioned.

"Millions and millions of dollars are squandered annually on manufacturing commodities to drawings that could be vastly improved as to materials of construction or as to design, and it seems to me that if this statement is true, as it undoubtedly is, it is up to this association to take the lead in remedying this uneconomic condition.

"I have tried to figure out some practical way by which we could, as a body, come into personal contact with the heads of departments and the teachers of our universities and technical colleges, with the thought in mind that the personal acquaintanceship would be broadening and beneficial if nothing more. I, however, think I can see how we could be helpful to each other in many ways, and the problems, that we might be glad of their help in solving, would lend zest to the students' work from the fact that they gave them direct contact with the industrial world.

"I see no reason why this cannot be accomplished by our visiting, at the time of our annual or semi-annual meetings, such schools as the university of Wisconsin, University of Cincinnati, Ohio State University, Case School of Applied Science, or any one of several others."

Brigadier General J. E. Fechet, assistant chief of air service, U. S. Army, spoke at the luncheon meeting on the subject, "Military and Commercial Aeronautics and the Problem Confronting Their Development."

General Fechet pointed out that commercial aviation is of prime importance from the military as well as the industrial point of view, stating that it has arrived in Europe but not in the United States.

The important facts relative to commercial aviation today, brought out by General Fechet, were that it will be a favorable adjunct to business, because of the close affiliation between business and transportation, each retarding or advancing the other.

That in some ways travel by air is much safer than is travel by other methods.

That transportation by air of freight suitable for such transportation leaves the ground available for heavier freight that need not be transported rapidly.

That development of commercial aviation is dependent to some extent upon the development of gears, because of the necessity of speed reduction between the motor, which has its power peak at about 2,000 r.p.m., and the propeller, which loses efficiency after its revolutions pass 1,200 per minute.

That in Europe insurance rates for transportation by air of certain objects have been cut to one-fifth of the rates for transportation by other means. Jewelry and bonds are of the class of freight referred to.

General Fechet has a very pleasing personality and is well equipped with facts. His talk was not a prepared speech and was quite informal. His audience was thoroughly appreciative.

Improvements Needed in Automotive Steels

A brief abstract of the talk given by W. G. Hildorf of the Reo Motor Car Co.

Everyone who has had experience with automotive steels has been confronted with problems which have been very difficult to solve.

The aim of this paper is to attempt to throw some light upon those baffling problems and to enumerate and elaborate upon them in the hope that we may have the co-operation of the steel companies in bringing about their solution.

In general, I believe the main problem, at least for the present, is one of obtaining greater uniformity from heat to heat, rather than attempting to produce new steels. In other words, it should be possible to obtain heat after heat of the same steel which could be forged, treated and machined alike; also it should be possible to use a standard heat-treatment and obtain hardness and physical properties within the limits usually allowed for that particular steel.

Any criticism in this talk is given as constructive criticism. I am not looking for a fight, but for co-operation and help from the steel companies.

The steel man has his troubles on account of the high temperatures at which he works. Metallurgy itself is so new that not all metallurgists agree on all specifications. Difference of opinion is one of the penalties of progress. If everything were standardized and everyone agreed, there would be no progress.

The above statements are not excuses for not increasing the general quality or making the steel more uniform from heat to heat.

Seams constitute one of the faults in steel. Inspection methods should be such that no seamy material leaves the steel mill for parts where seams would be objectionable, as in gear forgings.

Soft or spongy centers constitute another fault. Grain structure should be uniformly dense in order to have: uniform strength; uniform hardness; uniform resistance to wear; and freedom from warpage.

So far as chemical analysis is concerned there is no particular objection. All steels will meet chemical analysis. However, such analysis tells only part of the story.

There is trouble from dirty steels, the term being used to cover non-metallic inclusions, laminations and "stringers." It seems entirely likely that the dirt in steel is stretched, in rolling, into strings, that are among the causes of failures from the inside. Improvements have been made toward cleaner steels.

Abnormal Steels

It is very important to obtain normal steels. The abnormal steel is objectionable. According to the Bureau of Standards," an abnormal steel is more prone to soft spots than normal steel." Abnormal steels do not harden uniformly by ordinary heat-treatment, although they can be hardened in the cyanide and salt baths. Parts made from abnormal steels are likely to have soft spots or brittle cores, and to be warped in heat-treating. The steel mills can furnish normal steels.

Grain size varies enormously from heat to heat and to a lesser degree in the same heat. It does not seem possible by heat-treatment to bring grains

of different samples to the same size and keep them the same. Some are naturally large and grow rapidly, while others seem to be naturally small and remain small. A comparison of steels, one with large and one with small grain, both normal, shows that:

(a) Large grain grows rapidly.

(b) Small grain remains small.

(c) Small grain seems to go into solution more readily.

(d) Small-grained steel absorbs carbon more slowly.

(e) Small-grained steel has a wider hardening range.

Summary

The steel companies should maintain a system of inspection such that seamy stock, which would cause the customer trouble, would be stopped at the steel mill.

It should be possible to obtain a more uniform, dense structure, i.e., free from soft and spongy centers.

Improvements have been made in cleanliness of steel, yet the average quality is not satisfactory to the automotive metallurgist.

Regardless of whether or not it is possible by the use of salt baths to harden abnormal steels, the fact remains that "abnormal steel is more prone to give soft spots than normal steel." Therefore it is hoped that the steel companies will find it possible to so improve their practice that abnormal steels can be eliminated.

Fracture testing opens up a wonderful field for the improvement of automotive steels.

Grain size varies enormously from heat to heat. It is hoped that considerable work will be done along this line, because fine-grained normal steels seem to be much better than coarse-grained steels.

So far as I know this is the first paper that has ever been presented, in which the main object was to show the improvements needed in automotive steels. Let us hope that it will be accepted by the steel companies in the spirit in which it is given, namely, one of co-operation and help in producing a high-quality and more uniform automotive steel.

Other Papers

There follows a list of the papers given during all of the sessions of the West Baden meeting:

The Machine Hour Rate—an Ideal Foundation for Gear Prices, by E. A. Kebler, president of the Fawcus Machine Co., Pittsburgh, Pa.

Improvements Needed in Automotive Steels, by W. G. Hildorf, consulting metallurgist, Reo Motor Car Co.

Recent Developments in Gear Research, by Prof. C. W. Ham and Prof. J. W. Huckert of the University of Illinois.

The Rockwell Dilation Method for the Heat-Treatment of Steel, by Stanley P. Rockwell.

Measuring Gear Teeth, by J. L. Williamson, research engineer, the Fellows Gear Shaper Co., Springfield, Vt.

The paper by Mr. Williamson will be published in full in the next issue of the *American Machinist*. Some of the other papers will be abstracted.

National Safety Congress Stresses Need of Safety Education in Industry

Fourteenth annual meeting held in Cleveland last week

The fourteenth annual safety congress held under the auspices of the National Safety Council, closed a most successful four-day session on Oct. 2. The meetings were held in Cleveland, spreading the various programs over the auditoriums in the Hotels Statler, Winton and Cleveland.

Joining with the National Safety Council in this meeting were the National Civilian Rehabilitation Conference and the industrial nursing section of the National Organization for Public Health Nursing.

Sessions of particular interest to readers of *American Machinist* were held on Tuesday, Wednesday and Thursday. The program for the first session consisted of a symposium of fundamentals of industrial safety education presented from three important viewpoints. The fundamentals upon which a company must work were discussed by M. E. Danford, works manager, the American Rolling Mill Co., Middletown, Ohio. The important problem of personal contact between the company and the man was the subject of the address by Phillip Stremmel, assistant general superintendent, the National Enameling and Stamping Co., Granite City, Ill. The third phase of the problem, the steel worker and his characteristics, was presented by Arthur T. Morey, general manager, the Commonwealth Steel Co., Granite City, Ill.

Mechanical Problems

The second session was devoted to a discussion of mechanical problems. J. A. Hughes, superintendent of transportation and labor, Duquesne Works, the Carnegie Steel Co., discussed the safe transportation of steel products, with reference to plant railways, locomotive cranes, tractors and yard trucks; also the element of personal supervision and intelligent operation. W. F. Ames, of the McClintic-Marshall Co., Braddock, Pa., presented a paper on safe methods used in fabrication of steel, dealing with the laying out, cutting, shaping, refining, assembling, storage and shipping of steel for structural purposes. Other speakers took up the subject of "Hot metal and how to handle it safely," and "Safety achievements of the industry."

The third session was devoted to a round-table conference around the general topic "Observation, the Greatest Safety Instructor." Accompanying the discussion was an exhibition of stereopticon slides illustrating many valuable safety devices that have been developed in the industry during the past year.

In his address on "Safety Education" Mr. Danford said in part:

"I am asked to outline to you my concept of the fundamental principles which must govern an industrial company in its endeavor to properly educate its employees in safety.

"During the past decade and a half great safety evolution has been taking place in industry. The natural result of such progress was the elimination of the many and unworkable theories and the retention of a few time tried ideas which today have become so well known as to almost provide a catalog of truisms.

"One of the first fundamentals upon which the company must operate is to be thoroughly sold on the safety idea from the management's standpoint. Without this there can be no creation of a safety department, no safety committees to co-operate with the company, and no proof to the working organization that the company is interested in accident prevention. With this accomplished, however, the natural result is that a partnership in responsibility for safety and success is recognized. There are certain things which the company only can do in making the plant safe. Likewise there are certain things which the men must do. The company must recognize its responsibility for its part and must faithfully discharge that responsibility at all times.

"The company must betray a very great interest and enthusiasm in accident prevention, and no one will detect mockery and sham in this enthusiasm more quickly than the average workman. The leaders must, therefore, be thoroughly convinced that safety pays before they can successfully teach it to their organization.

"All endeavors of this kind cost money—but the returns are large. Therefore, a proper measure of financial assistance must be determined upon and a willingness must be shown to take those safety precautions, and to provide that safety assistance which will produce the results. The expenditure of money for accident prevention must not be of a spasmodic or seasonable nature.

Personal Interest Impresses

"One of the things which impresses upon men the sincerity of the boss in this matter is the attention he pays to safety guards and to safety equipment. The manager must take a personal interest in seeing that all possible mechanical safeguards are installed and properly maintained, and he must also be ready and very willing to receive suggestions and to act quickly upon those chosen for trial. Nothing will more quickly nor surely dampen the enthusiasm in the entire program than to have those in authority appear indifferent toward the safety suggestions of an employee. It must not be forgotten that the individual submitting a suggestion for the betterment of safety has done so only after considerable thought and effort have been expended on the subject, and as a result he is jealous of the idea. For example, his suggestion may have

to do with some mechanical contrivance. The workman, after careful thought, has conceived the basic idea underlying the design of the contrivance. It will never be practicable however, until some engineer has developed the idea to mechanical workability.

"Once this is accomplished the workman with the original idea should have full credit for the finished product. A careful periodic plant safety inspection serves to keep the subject before all the men and to present to them constantly the idea that the company is behind the safety program and is desirous of their help. And this subject must not be allowed to fall into the opportunist class, nor can safety be successfully taught by spurts. A working force becomes a safety force in the same manner as a child learns to play the piano—by constant practice and daily thought.

Safety Assures Speed

"Many managers have been deluded by the idea that safety is antagonistic to high production standards. They feel that safety and slowness, accident prevention and apathetic production are synonymous. The safety records of some of the best and most efficient plants of the country effectually contradict this mistaken idea. Given machines, properly safeguarded mechanically, manned by a crew of alert and active men well grounded in accident prevention, working in a plant pervaded by a veritable atmosphere of safety, what need is there for a funeral pace and an increased production cost. Rather the opposite is true. The dangerous parts of the machine are known to be properly protected and the men know what to do to avoid accidents and they go on their way cheerfully producing at a high rate and yet safely. If this ideal be attained it is an easy task for the management to show its organization that safety is profitable. They can readily see that safety pays them in more days at work, less physical discomfort and a happier home; and it is good business for the company to frankly admit that safety pays it also in reduced compensation, less medical and hospitalization expense, less absenteeism among its skilled force necessitating substitutions which frequently spoil work and impair crew efficiency, and a higher standard of operation than its less highly organized competitors. It should be clearly understood that the company and the men are in partnership in this safety business. The men will respect the company's teaching the more when they understand its motive.

"There is no secret formula or cabalistic prescription which governs the success or failure of the safety doctrine in any plant. And I make this statement regardless of conditions unless these be so abnormal as to nullify all efforts of any kind. Native or foreigner, white or black, union or nonunion, men everywhere will respond to the doctrine if properly presented. Some may be slower than others—some may scout the theory more vigorously, some may even temporarily stir up opposition, but if the matter is made plain, and if the safety educational work is followed up patiently and persistently it will ultimately succeed.

"I know of a company whose president has been preaching for many years from a text composed of three words. These three ideas form a progression of human relationship which effectually quells distrust and suspicion and results in a high degree of team work.

"The first essential in organization is *understanding*. Men who thoroughly understand each other rarely fight, they respect each other's principles though they may not agree, and because of their understanding they come to believe in each other because they know the reasons which animate them. With a complete understanding, men soon learn to experience the second emotion —*confidence*. When a company and its employees have so progressed on the road to success as to have a thorough understanding in their daily relationship—when the men understand the reasons for the company's rules and requests, and appreciate their reasonableness, they acquire confidence in the company's motives.

"The natural result of understanding and confidence flows forth in harmonious *co-operation*. No company every failed where there was thorough co-operation in all departments. Why? Because the result of these three ideals is *accomplishment*—the goal. And so in viewing the field of safety endeavor the company which would succeed in its presentation of the safety doctrine should adopt these three fundamentals as foundation stones for its structure."

Industrial Engineers Elect Officers

At the conclusion of its annual meeting held on Sept. 29 at Detroit, the Society of Industrial Engineers announced the election of the following officers to serve through 1925-1926. Walter F. Rittman, of the Carnegie Institute of Technology, president; Perry A. Fellows, Detroit, vice-president in charge of research; Charles B. Gordy, University of Michigan, vice-president in charge of education; W. W. Nichols, Detroit, vice-president in charge of promotion; S. F. Mitzner, the H. N. Stronck & Co., Chicago, treasurer; George C. Dent, Chicago, secretary.

The thirteenth annual convention of the society will be held June 16, 17 and 18 at Philadelphia.

Funds Needed for Ordnance

If the Director of the Budget is not more liberal this year with the Ordnance Department of the Army further curtailment of research and experimental production of armament will be made necessary. Since the war the department has been able to maintain a reasonable volume of work on the small appropriations that have been allowed, because of the war surplus from which it could draw. This surplus now has been exhausted. Even in the matter of ammunition the end is in sight. Deterioration has proceeded to a point where no great amount of the war surplus can be used.

August Exports Increase Over Last Year

Exports of metal-working machinery for August, with revised comparative figures for August, 1924, as compiled by the Department of Commerce, are as follows:

Exports	August, 1924 Value	August 1925 Value
Lathes	$141,602	$307,652
Boring and drilling machine tools	49,711	87,679
Planers, shapers and slotters	41,923	63,724
Bending and power presses	36,644	39,145
Gear-cutting machines	37,425	64,041
Milling machines	71,935	208,230
Thread-cutting and screw machines	46,058	113,535
Punching and shearing machines	24,451	16,004
Power hammers	17,655	16,490
External grinding machines	126,990	146,760
Internal grinding machines	51,982	86,822
Other grinding and sharpening machines	35,449	41,888
Chucks for machine tools	31,172	34,166
Reamers, cutters, drills, taps, dies, and other metal-working tools	146,060	280,015
Pneumatic portable tools	92,236	82,236
Foundry and molding equipment	57,153	59,772
Other metal-working machinery, and parts of	380,197	502,705
Metal-working machine tools (total)	$1,388,645	$2,150,864

Employment Reaches Highest Level in Detroit

A new high peak for all time has been reached in Detroit's industrial employment. Approximately 375,000 workers are employed in factories here at present, the greatest number ever enrolled. The Employers' Association of Detroit, representing two-thirds of the factory employees of the city, reports that for the week ended Sept. 22, a total of 255,129 workers were employed by the factories represented. This was an increase of 4,534 the week previous and a jump of 57,273 over the corresponding week of 1924.

Increase Started in August

Employment has maintained a high level since early in the year, which has been comfortably in advance of employment during the corresponding period of 1924. The total number of workers has been showing a steady increase since the latter part of August.

One reason for the record employment has been the tremendous pace maintained by the automotive industry since the early months of 1925. The introduction of new models last month and the record-breaking output since that time accounts in large measure for the recent generous increase of employment.

It is pointed out by the Employers' Association, however, that the increase has been general and not restricted to any one industry. It has been a fact that practically all the plants in this territory have been active and that all are employing more men than in former years. This has boosted the total employment to a new high level. Many plants have been adding new men during the past few weeks and are continuing to do so at a fair rate at present.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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WITH the advance of autumn it is quite natural that the business landscape should become less brilliant in its coloring.

Bank clearings, railway traffic and retail trade all indicate increased activity, and its continuance is predicted by most of the monitors upon whom the public rely. There are, however, some aspects in which the outlook seems less roseate and the conscientious observer cannot ignore them. One is the decline in farm products. It is estimated that during September the leading American grain crops suffered a depreciation of more than $400,000,000.

Since the fifteenth of September wheat has fallen about 12 cents, while corn and rye both declined 8 cents a bushel. This reduces the purchasing power of the Western farmers, particularly if it be true that much of the winter wheat produced has been held back. The value of cotton has also declined nearly two cents a pound, or $10 a bale, and this means a reduction of about $140,000,000 in the gross income of the Cotton States.

It is true that live stock, white potatoes, rice and some fruits are still relatively high, but the prices at which these frequently forgotten items in our agricultural inventory are selling are chiefly the result of under production and only the fortunate few among the farmers are benefited by crop failures.

Taken altogether it seems probable that the autumnal decline in the value of our agricultural production is at least $600,000,000, and while this may not mean much in a country as rich as ours its psychological effect upon those who have raised the depreciated crops may be to check spending and induce a return of the agrarian discontent that is so nearly chronic in this country. So perhaps former Governor Lowden of Illinois may have been right last week in telling the American Bankers' Association that it was a mistake to assume that any permanent solution of the agricultural problem in the United States had as yet been reached.

At all events the decline in the value of our farm products is a fact that should be taken into account, as is the recurrent advance in the rate for call money that is reported on the Stock Exchange from day to day. They are cautionary signals. They mean "go slow" and there is some reason to believe that they are being heeded.

The weekly statement of the Federal Reserve Banks does not show any changes of importance and the action of the Bank of England in reducing its rate to 4 per cent is taken to indicate that the Federal Reserve rate here will not be advanced. But the American stock market has halted nevertheless, and bonds have been weak at times.

What's Doing in Industry

Machine tool and machinery sales have settled down to a volume that is more or less steady. Good business is reported from practically all prominent industrial centers, and the outlook for the next two months is quite satisfactory.

Cincinnati reports an increasing demand from all parts of the country, 50 per cent of orders coming from the automotive industry. Chicago also reports a better condition. Detroit is still the center of activity, with automobile plants furnishing orders as new production schedules are planned.

New York dealers are doing a steady volume of business, railroads and industrialists buying in small quantities as the need arises. Buffalo reports a healthy improvement in general activity, with a corresponding increase in the demand for machinery. In Canada the expansion of electrical and other manufacturing industries has furnished added business for dealers in machine tools and allied equipment.

According to figures just compiled by the Department of Commerce, August exports of machine tools and metal-working machinery increased over the same month last year by about $800,000. Lathes and milling machines show the greatest gains.

Bank clearances, railway traffic and retail trade all indicate general prosperity and a good fall business is predicted in all lines by commercial authorities.

Possibly the hesitation may have been due to the belief or fear that a settlement of the French war debt to the United States would be followed by a flood of foreign loans that would soak up all of our liquid credit.

It is said that more than a billion dollars of such loans are now being sought here but it is not altogether certain that the agreement to defer a final settlement of the French debt for five years will justify their flotation.

But it is at least clear that Europe stands ready to take all the money that we will lend and it is equally clear that if we continue to lend we must export capital and import goods, thereby reducing the favorable balance of trade formerly regarded as the exponent and measure of American prosperity.

But these somewhat distant possibilities do not obscure the living present and its satisfactions. Among them one of the most evident is the increased activity in the dry goods market. Woolens, silks and cotton goods are all in active demand at fair prices. The improvement is particularly noticeable in cotton goods, which have been but little affected by the decline in raw cotton. The result is that the cotton textile industry seems to be coming into its own again.

There is also affirmative evidence of an improvement in the steel industry, and pig iron is slightly higher despite the continued and unusual importation of the East Indian article. This is one of the anomalies of commerce, for very few people ever expected that East India would be able to ship pig iron to the United States.

Another anomaly is the continued weakness of copper in the face of the largest consumption in the world's history. It is due to the cheapness with which copper can be and is being mined in South America.

Coffee is slightly lower, but it is still at an artificial price made possible by the success of the Brazilian or Sao Paulo government in impounding and rationing the supply. It seems inevitable that the dam will give way some time, but no one can say when.

Wheat has confounded the bulls by its weakness, but it seems to have reached a level at which it shows some resistance and millers have been free buyers at the decline.

But all these details are comparatively unimportant until they affect the psychology and the purchasing power of the ultimate consumer. As yet he seems unconscious of them and until he became aware of them and commenced to tighten his purse strings business will be good, although speculation may languish, as it now seems inclined to do.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

Detroit

Very little change in the machine tool and machinery markets has taken place during the past week, sales remaining quite satisfactory, with a slight decline noticeable from the heavy buying which featured the summer months.

In spite of the apparent slackening of the market as a whole, some representatives of machinery manufacturers report business as being excellent. Demand for tools and equipment is being confined to fewer plants, now that production has reached its peak.

The Ford Motor Co. is back in the market for large quantities of machinery. For the first time in two years the Highland Park and River Rouge plants are turning out cars to their capacity. The rush of orders for the new Fords has exceeded the expectations of officials, and from all accounts the plants will be run to capacity for some time to come.

Electrical heat-treating furnaces are being installed at the Rouge plant now. Machinery for the spring and upset building, as well as for the pressed steel building is being set up. Punch presses, curling machines, hydraulic presses, and upsetting machines constitute part of the new equipment at the Ford plants.

Second only in importance to the strides being made by Ford, is the two-million-dollar expansion program to be undertaken by the Willys-Overland plant in Toledo. A complete new forge unit will replace the present structure.

This new unit will be composed of two new large buildings, one to house the hammer shop and another for the heat-treating departments. Thousands of dollars worth of new machinery and equipment will be added to this one unit alone.

All paint and enameling ovens in the Willys-Overland plant will be completely revamped, and a huge new machine shop adjacent to the Mather spring plant will also be built, necessitating the purchase of new equipment.

Confirmation of the reports to the effect that the General Motors Corporation would introduce a new light six-cylinder passenger car around the first of the year has been given through the recent public announcement of the corporation's plans by officials. The new car, whose name is unknown as yet, will be produced at the plant of the Oakland Motor Car Co., at Pontiac, Mich. Approximately three million dollars will be spent for equipment, machinery and tools, it is understood.

Cincinnati

The past week's increased demand for machine tools is attributed by Cincinnati manufacturers and selling agents to the fine weather that has prevailed. All agree that the market has grown decidedly more active in all districts.

It is reported that the number of foreign orders received has increased more than was expected, and it is conceded that the export situation is getting much better. Railroads have done considerable buying of single tools, but no large orders are reported. However, there is a persistent rumor that one railroad will place a large order in a few days, and it is thought that others will be compelled to do likewise in the near future.

General orders coming in are well distributed over the country. The demand has become more steady as to volume, with fewer peaks and valleys in the sales curve.

The feature of the past week has been the demand from concerns in the automotive industries, to which field some manufacturers state approximately 50 per cent of their output is going. Automobile repair shops, it is stated, are buying an increased number of small machine tools.

Selling agencies report that in the past week there have been an increased number of sales to local machinists and industrial users of machine tools.

Chicago

Industrial demand for machine tools and special machinery has shown marked improvement during the last week, dealers in general reporting inquiries to be more numerous and sales better than for several weeks past.

One large handler of used machinery in commenting on market conditions took occasion to remark that not in several years had so many prospective buyers visited his salesrooms. This is partly accounted for by the national radio exposition now being held here and the presence in Chicago of numerous radio manufacturers.

Considerable interest is being manifested in connection with the announcement that the Florida & East Coast R.R. is in the market for special machinery and machine tools for the equipment of new locomotive and machine shops to be located in St. Augustine, Florida. A number of Chicago dealers have been asked to submit bids on woodworking and metalworking machine tools the, latter including practically every kind and variety of tools used in railroad workshops. Beatty & Kipp, Chicago engineers, are said to be acting for the railroad in asking bids, but dealers are reticent as to the details connected with inquiries.

Indianapolis

A more optimistic outlook for winter is reflected by the machinery and tool interests here. Manufacturers and dealers both say business in tools and machinery is picking up and a large volume of inquiries indicates more business for winter. There is little doubt that the last six months of this year will be better than the same period of last year. In the first place there is a little more tool business from the automobile industry in this state. In view of optimistic reports fom the plants the machinery men are expecting some replacements before long. In fact some inquiries now are being received.

The last two weeks have witnessed more activity on the part of mine owners in the Western part of the state.

A few calls are being received for special machinery for furniture factories, most of which are operating nearly to capacity. Demand for special machinery for lumber manufacturers both in the West coast and the Southern field continues good. Dealers in used machinery report a little more business, but the situation is not satisfactory.

Buffalo

Conditions in the machinery and equipment field here show a healthy improvement over conditions of two weeks ago. There are some dealers who feel that they are not doing the business they should, but the reports on the whole are very encouraging for the season.

Considerable interest was aroused by the inquiry of the Syracuse Washing Machine Co., in the market for new machinery for the production of a new model.

Buffalo industries are showing the greatest activity in many months. For the last half of September the power consumption graph of the Buffalo General Electric Co. shows a new high record and for the first time in the history of the city, the power curve ran above the 10,000,000 kw.-hr. weekly line. Statisticians of the company estimate an increase of 15 per cent in the city's industrial activity over 1924.

New York

The first week in October brought little or no change in the machine tool and machinery market in this district. Sales have been progressing evenly, with no large orders reported. Inquiries have dropped off to some extent, but it is believed that there are sufficient lists on the market now to keep dealers busy for some time.

The tone of the market, however, is decidedly better, and business now under way should materialize this month and show a substantial total for the month.

Railroads and industrialists have been the buyers of lathes and milling machines in the past week. The New York, New Haven & Hartford purchased a 100-in. vertical boring mill and a 6-ft. radial drill. The Seaboard Air Line bought two turret lathes; the Nickel Plate road bought a large locomotive axle turning lathe; and the Chicago, Milwaukee & St. Paul a 16-in. toolroom lathe and a 10-in. shaper. The General Electric Co. placed orders for a 10-in. shaper and four 16-in. lathes.

Business in small tools and miscellaneous shop equipment has shown signs of picking up this month. Orders for this class of merchandise have appeared in greater numbers in the past week.

Canada

A healthy improvement in industrial activity in Canada is indicated by the fact that orders for machine tools are growing and, at present rates of production, some plants are finding it difficult to keep abreast of shipment demands. An indication of growing business in the metal markets is found in the August figures on iron and steel output. Production of coke pig iron was 26,513 long tons, an advance of 27 per cent over July figures. Basic pig iron increased from 73 tons in July to 5,308 tons, indicating substantial improvement in activity in steel mills.

Employment figures, too, are encouraging. During August, employment in manufacturing showed an increase which exceeded the decline recorded in July. The largest gains were in iron and steel, pulp and paper and non-ferrous metal works. Steam and electric railways and forwarding companies are busier and are now entering the market for equipment. The Algoma Steel Corporation has received a rail order from the Canadian Pacific Ry. which will keep its mill busy for at least two months. The Steel Co. of Canada is engaged in rebuilding one of its two blast furnaces. The plant of the Dominion Alloy Steel Corporation, at Sarnia, Ontario, is operating 24 hours a day.

Among important contracts awarded recently was one to the Dominion Bridge Co. for building the steel superstructure of the Montreal-South Shore bridge. Much of this work will be done in the shops and it is expected that nearly 500 men will be employed in forging the 30,000 tons of steel which will be used.

What the Railroads Are Doing

The net operating income of the seventy railroads reporting aggregates $106,519,000 and compares with $82,354,000 shown by these carriers in August, 1924, an increase of $24,565,000, or 29.8 per cent. In July this year their net was $86,306,000, August showing an increase of $20,213,000, or 23.4 per cent.

Assuming that the balance of the roads to report will maintain about the same ratio to total net, August net for all Class 1 carriers will total around $122,000,000, comparing with actual net of $95,415,000 a year ago, and $99,462,000 in July, 1925.

Net of $122,000,000 would represent the month's proportion of an annual rate of 5.41 per cent on a property valuation for rate-making purposes of $20,500,000,000, against rate of 5.56 per cent in July and 4.78 per cent in August, 1924, on a valuation of $19,745,000,000. Eight months' net would total $659,165,000, or at annual rate of 5.31 per cent, compared with 4.70 during the same period last year.

Gross revenues for the roads reporting totals $491,573,000, comparing with $451,661,000 a year ago, an increase of 8.8 per cent, while in July they had gross of $464,848,000.

W. J. Harahan, president of the Chesapeake & Ohio Ry., announced last week that a contract had been awarded the Baldwin Locomotive Works, of Philadelphia, for the building of twenty mallet locomotives at a cost of $2,250,000. Mr. Harahan also announced the award of a contract for building 100 steel underframe caboose cars at a cost of $250,000 to the Standard Tank Car Co., of Sharon, Pa.

Fewer locomotives were in need of repair on Sept. 1 this year than at any time since Jan. 1, 1924, although freight traffic, measured by the number of cars loaded with revenue freight, is heavier now than ever before on record according to the latest reports filed. The total number of locomotives in need of repair on Sept. 1 this year was 10,551, or 16.5 per cent of the number on line. This was a decrease of 413 compared with the number in need of repair on Sept. 1 last year.

The New York, New Haven & Hartford has contracts under negotiation for the purchase of 10 Mountain type freight locomotives to be equipped with McClellan boilers.

The Louisville & Nashville has ordered eight locomotives from the Baldwin Locomotive Works.

The Illinois Central R.R. has announced that it has awarded contracts for the purchase of 1,000 box cars and that it expects to close contracts covering the purchase of 200 stock and 200 flat cars during the next two weeks.

The St. Louis-San Francisco is inquiring for 3,000 box cars. This road is also inquiring for 3,000 single sheathed box cars of 50 tons' capacity.

The Baltimore and Ohio has ordered 1,000 hopper car bodies from the Standard Steel Car Co. This road is also reported as being in the market for 1,000 box car bodies.

The New York Central has ordered 500 70-ton hopper cars, from the Pressed Steel Car Co. and 500 from the Standard Steel Car Co. for service on the Pittsburgh & Lake Erie. Orders have also been placed for 1,000 refrigerator cars with the Merchants Dispatch Transportation Co.: 500 of these cars will be assigned to the New York Central and 500 to the Cleveland, Cincinnati, Chicago & St. Louis.

Brief Facts About Industries

E. H. Rollins & Sons, Blair & Co., Halsey, Stuart & Co. and Parkinson & Burr announce the bonds have been sold and the books closed on the offering of $8,500,000 the Walworth Co. first mortgage sinking fund gold bonds, Series A, 6 per cent.

Blair & Co. and E. H. Rollins & Sons announce the $2,500,000 Walworth Co. 6½ per cent sinking fund debentures have been sold and the books closed.

This financing is in connection with the acquisition of the Kelly & Jones Co. by the Walworth Manufacturing Co., of Massachusetts, which will change its name to the Walworth Co. The business of the Walworth company has been in existence for more than 80 years and that of the Kelly & Jones company for more than 50 years. The merger will make the Walworth company one of the largest producers of steam, gas, water, oil and air-line fittings and valves in the United States. Outstanding first mortgage 7 per cent sinking fund bonds of the Walworth Manufacturing Co. will be called for payment on Jan. 1, 1926, at 108 and accrued interest.

Work of co-ordinating the manufacturing facilities recently acquired by the Servel Corporation, consisting of the plants of the Hercules Manufacturing Co. and the Wheeler Condensor and Engineering Corporation, has progressed to a point where the output of the Hercules plant has been about doubled.

The manufacturing activities have been so divided that the Wheeler plants are being used to turn out the commercial refrigerating units while the Hercules plant is making the household type machines.

The manufacturing personnel of the Hercules company has been augmented by production men put in by the Servel Corporation, while additional facilities have been installed for mass production of refrigerator units. Factory space has been rearranged making for more economical operation of the various departments.

In structural steel work, involving bridges and large buildings, a seasonal decline in consumption might now be expected, but structural steel bookings, which precede by months the actual erection of steel and completion of the structures, do not betoken a seasonal decrease, the statistical showing being quite otherwise.

Lettings of fabricated structural steel contracts in the past three months, as computed by the Department of Commerce, are about 722,000 net tons, which is record high for any three consecutive months, yet the shipments fell a trifle short of the bookings and the shipments since Jan. 1 were only 3 per cent in excess of the bookings. That is, the fabricating shops lost only about a week from their order books in eight months, while on Jan. 1, with spring and summer ahead, they were quite well booked.

News of the Automotive Industry

Ford production is rapidly reaching normal again after delays incident to bringing out the new models. Output last week averaged 6,800 cars a day, of which 1,500 were trucks.

The production of the majority of other manufacturers is continuing at high levels although there are one or two instances of slowing down.

The Packard Motor Co. declared a quarterly dividend of 50 cents, payable Oct. 31 to stock of record Oct. 15, placing the stock on a $2 annual basis. The preceding quarterly payment was 30 cents regular and 50 cents extra.

The Cadillac Co. has 6,000 unfilled orders, according to Lawrence P. Fisher, president of the Cadillac Co., and vice-president of General Motors. "We are producing 3,000 cars a month, and on Oct. 1 we expect to increase production to 3,500 cars," says Mr. Fisher. "We are working nights and Sundays now to catch up with our business."

The profit of the Paige-Detroit Motor Car Co. and subsidiaries for August was $532,281 after depreciation and interest, but before federal taxes. Profit for eight months ended Aug. 31, 1925, totaled $2,834,126 before taxes, equivalent after allowing for 7 per cent preferred dividend requirements to $4.03 a share earned on 676,500 no-par shares of common stock.

A recent news dispatch says that the twenty or more stockholders of the bankrupt Gary Motor Truck Co., which went into hands of receivers more than five years ago, may be forced to pay $213,000 in creditors' unsatisfied claims as result of finding of Harry Sheridan, referee in bankruptcy in Federal District Court at Hammond, Ind. The principal creditors are the Timken Axle Co., Detroit; the Midland Steel Co., Cleveland; the Buds Motors Co., Chicago, and the Joseph T. Ryerson Steel Co. Plant and physical assets of Gary Motor Truck Co. were purchased at trustees' sale by Gary Motors Co. several years ago. The new company is not involved in the present federal proceedings.

The General Motors Corporation is planning a new automobile which will be produced and distributed by its Oakland Motor Car Division as companion to the present Oakland Six, according to an early announcement from the company.

The space for building this new car is available in the Oakland factory at Pontiac, Michigan, because the Fisher Body Co. has erected a $2,000,000 building in Pontiac in which to build all Oakland bodies.

The program with regard to this new product has not advanced sufficiently for General Motors to make public at this time the price and specifications and the field this new car will cover.

Personals

D. G. CAYWOOD, who for several years has been manager of the Boston branch of the Black & Decker Manufacturing Co., has been promoted and will now act as a special representative for the company on various types of special work. A. D. Geiger, formerly salesman in the Kansas City branch of the Black & Decker Manufacturing Co., has been selected to take Mr. Caywood's place in the Boston branch.

LAWRENCE P. FISHER, president of the Cadillac Motor Car Co., of Detroit, sailed for Europe last week. While abroad Mr. Fisher will make preliminary arrangements for the establishing of Cadillac factory branches in England, Belgium and Italy.

R. E. BOCK has been appointed district manager in Chicago for the Ohio Electric and Controller Co., of Cleveland. Mr. Bock will be located at 53 West Jackson Blvd., Chicago.

FRANK J. TRIPPENSEE has resigned as president and general manager of the Trippensee Closed Body Corporation of which he has been the executive head since 1904. He will retain his membership on the board of directors, as well as his position on the board of the Rickenbacker Motor Co., which company has now acquired a controlling interest in the Trippensee Body plant.

J. S. HUNT has been appointed vice-president in charge of manufacturing of the Star Division of Durant Motors, Inc. Mr. Hunt was general factory manager of the Star Division at Elizabeth, N. J., where he will continue to operate in his new position.

PERCY OWEN, chief of the automotive division of the Department of Commerce, has resigned to join Dodge Brothers, Inc., of Detroit, as director of foreign sales.

HENRY HAMILTON SEABROOK, manager of the Philadelphia district branch of the Westinghouse Electric and Manufacturing Co., was entertained at a luncheon in the Manufacturers' Country Club, Philadelphia, last week. The occasion was the completion by Mr. Seabrook of tweny years of active service as the district manager.

WILLIAM F. M. GOSS, for eight years president of the Railway Car Manufacturers' Association, and for forty years active in the affairs of the American Society of Mechanical Engineers, retired on Sept. 1, and has moved to his home town, Barnstable, Mass.

HUGO DIEMER, vice-chairman of the Chicago Section of the A.S.M.E., has been elected president of the Chicago Chapter of the Society of Industrial Engineers.

DAVID M. MEYERS, consulting engineer to the U. S. Bureau of Mines, has established offices in the Metropolitan Tower, New York, to engage in the practice of industrial power plant economy.

C. F. KENRICK has been transferred to the Cleveland office of the Ingersoll-Rand Co.

W. R. THURSTON has been transferred from the New York to the Chicago office of the Worthington Pump and Machinery Corporation.

E. B. STANLEY has been elected president of the American Laundry Machinery Co, of Chicago.

H. D. RUMSEY has been elected president of the Romeo Foundry and Machine Co. of Romeo, Mich.

C. G. WENNERSTROM, formerly of the Allbright-Nell Co., of Chicago, has joined the engineering force of the Foote Bros. Gear and Machine Co., of Chicago.

MALCOLM BLUE, superintendent of the Pictou County works of the British Empire Steel Corporation has resigned, and will be succeeded by Daniel MacLean, who for some time has held the position of assistant general superintendent.

CLAUDE E. GAUSDEN, acting general manager of steel sales for the British Empire Steel Corporation since the death of E. P. Merrill, has been permanently appointed to the position.

W. H. FARRELL, former general manager of the Algoma Eastern Railway, has been appointed assistant to vice-president Hungerford of the Canadian National Railways. Mr. Farrell was at one time general superintendent of the Grand Trunk Railway.

C. E. DAFOE, general superintendent of the Midland Railway, has been elected chairman of the operating committee of the Railway Association of Canada, succeeding A. E. Warren, recently appointed general manager of the Canadian National Railways at Toronto.

Business Items

The Todd Dry Dock Engineering and Repair Corporation has been organied, the new company being the result of the merger of the Tebo Yacht Basin Co., the Clinton Dry Docks, Inc., and the Todd Oil Burner and Engineering Corporation. The new organization will be located at the foot of Twenty-Third St., Brooklyn, N. Y., with offices at 25 Broadway, New York City.

The C. F. Bulatti Machinery Co. has moved to new quarters at 829 Folsom St., San Francisco.

The Commercial Grinding Wheel Co., of Chicago, has acquired a new plant at 4507 Armitage Ave., in Chicago.

The Tucker Foundry Co. has been organized at Medina, N. Y., to carry on the business of the Central Foundry Co., which closed recently.

The Yates-American Machine Co., has been organized, being a merger of the P. B. Yates Machine Co., of Beloit, Wis., and the American Woodworking Machinery Co., of Rochester, N. Y.

The Southern Distributing branch of the Fairbanks-Morse Co., has been moved from New Orleans to Birmingham, Ala.

The Paulsen & Nardon Tool and Die Works, of Los Angeles, has removed to new quarters at 1255 East 9th St.

Five Cincinnati machine tool manufacturers—The Cincinnati Planer Co., the Cincinnati Bickford Tool Co., the Cincinnati Milling Machine Co., the Lodge & Shipley Machine Tool Co., and the Acme Machine Tool Co.—have given exclusive sales rights in the Southern territory to the following firms: Woodward, Wight & Co., Ltd., New Orleans; the Huey & Philip Hardware Co., Dallas; the Hausman-Harwick Machine Tool Co., Birmingham; and R. S. Armstrong Bro. & Co., Atlanta.

The Air Reduction Sales Co., of New York, has served notice to users of oxy-acetylene processes, in regard to the utilization of apparatus of the Messer and Heylandt types manufactured in Germany. There is a suit pending now in the U. S. District Court, in Delaware, against a user of similar equipment because it infringes on patents owned by the Air Reduction Sales Co.

George D. Haskell, of Springfield, Mass., president of the Bausch Tool Co., of that city, has entered a $15,000,000 suit in the Federal Court against the Aluminum Company of America and its officers and directors for an alleged conspiracy in restraint of trade and the maintenance of a monopoly. The bill alleges that Mr. Haskell uses large quantities of aluminum in his business and has always experienced great difficulty in getting a proper supply of it because of the existence of a monopoly in the manufacture and sale of the metal.

The manufacturing plant of the Majestic Engine Co., at Goshen, Ind., has been sold to the T. A. Bartlett Co., of Chicago. The Bartlett company will form two Indiana corporations and manufacture electric lathes and build storage batteries.

The M. P. Dahl Tool and Die Co., has opened a plant at 106 West Twelfth St., Indianapolis.

The Black & Decker Manufacturing Co., announces the removal of its Boston branch office to new and larger quarters located at 62 Brookline St. The building at this address is of steel and concrete construction, with large show windows.

The Crocker-Wheeler Co., of Ampere, N. J., announces a change in the company name, effective Nov. 1. The new name of the company will be Crocker-Wheeler Electric Manufacturing Co.

The Wagner Electric Corporation, of St. Louis, announces the removal of its Dallas office and service station to 2815 Commerce Street.

Obituaries

CLARENCE O. BARRIE, general superintendent of equipment and maintenance for the Allis-Chalmers Manufacturing Co., Milwaukee, and W. R. FORTNEY, mechanical engineer, of Waynesboro, Pa., were killed on Sept. 28 when Mr. Barrie's automobile was struck by an express train just outside of Milwaukee. They had been in conference at the Allis-Chalmers works and were on their way to Cudahy, a suburb, to inspect equipment in the plant of the Worthington Pump and Machinery Corporation, which some time ago disposed of the Cudahy business to Allis-Chalmers. Mr. Barrie was 51 years of age and became associated with the Allis-Chalmers company in 1906. Only a few weeks ago he returned from a three month's business and recreation trip to Europe.

A. A. TIRRILL, consulting engineer with the Westinghouse Electric and Manufacturing Co., died at his home in Pittsburgh on Sept. 21. Mr. Tirrill was awarded the John Scott Medal in 1914 for his work in the engineering profession.

CARL A. LAUTZ, a director of the Niagara Machine and Tool Co., of Buffalo, died last month at his home in that city.

LLOYD HARRIS, a director of the Massey-Harris Harvester Co., Inc., and prominent in the industrial life of Canada, died at his home in Brantford, Ontario, on Sept. 27. He was 59 years old. In 1881, at the age of 21 years, Mr. Harris became European representative of the old Harris Manufacturing Co. and inaugurated exports to Russia and Siberia, thus laying the foundation of Canada's world-wide trade in agricultural implements. For nine years after the merging of the Harris and Massey firms he was European manager, and returned to Canada in 1900. Still holding an interest in the Massey-Harris firm he became associated with many varied enterprises. He was president of the Russell Motor Car Co., Ltd., Toronto; president of the Under Feed Stoker Co. of America, Detroit; vice-president of the Willys-Overland Ltd., Toronto, and a director of many other companies.

HAROLD R. HARMER, secretary-treasurer of the Montreal office of the A. R. Williams Machinery Co., died recently after a brief illness. He was 46 years old.

HARRISON PIERCE REED, general manager of the A. Kieckhefer Elevator Co., Milwaukee, manufacturers of freight and passenger elevators, died on Sept. 27. He was born in Milwaukee thirty-nine years ago and was graduated from the electrical engineering department of Cornell University, then joining the Cutler-Hammer Manufacturing Co. On May 1, 1922, he resigned to become general manager of the Kieckhefer Company. He was a member of the American Society of Electrical Engineers and a well-known contributor to the literature of his profession.

Pamphlets Received

The Job Blue-Print. Published by the Metropolitan Life Insurance Co., 1 Madison Ave., New York, N. Y. No. 5 in the series of Personnel Leaflets prepared by the Policyholders' Service Bureau. This pamphlet in twelve pages discusses the specifications that should be given to the personnel manager in order that he may know what the job is and the character of employee desired to fill the position. Methods of job analysis used in several large concerns are briefly outlined.

Trade Catalogs

Recording Pyrometers. The Brown Instrument Co., 4501 Wayne Ave., Philadelphia, Pa., has published a ten-page booklet describing the new design of Brown recording pyrometers. Details of the instrument are fully illustrated and paragraphed explanations accompany the photographs.

Soot Blowers. Diamond Power Specialty Corporation, Detroit, Mich. "The Best Paying Investment in the Power Plant," is the title of a 32-page booklet, 8½x11 in., showing the features of design of Diamond "valve-in-head" automatic soot blowers, and the points at which a saving may be expected from the use of this equipment.

Tool Steels. Firth-Sterling Steel Co., McKeesport, Pa. A 96-page book, 6x9 in., cloth bound entitled, "Simplified Shop Tooling," has been published to cover the Firth-Sterling lines of steel. Many photographs are included to show the process of manufacture and the applications of Firth-Sterling steels.

The book discusses the work for which the different grades of steel are designed and the reasons for their use. Die steels, drill rods, tool bits and other tool-steel products of this company are described. Tables list the prices and weights of the forms in which these steels may be obtained.

A section of the heat-treatment of the steels discusses the handling of the different grades.

Transformers. The Kuhlman Electric Co., Bay City, Mich., has published "Over 30 Years of Uninterrupted Service to the Electrical Industry." It covers the Kuhlman line of transformers and describes the applications, advantages and disadvantages of the models. The methods of operation and setting up are detailed and photographs show actual installations. Specification data tables give the sizes, capacities and prices of the equipment. The bulletin contains engineering data and material for the electrical or consulting engineer and also for others.

Forthcoming Meetings

American Foundrymen's Association. Annual meeting, State Fair Grounds, Syracuse, N. Y., Oct. 5 to 9. C. E. Hoyt, secretary, 140 So. Dearborn St., Chicago.

Motor and Accessory Manufacturers' Association. Fall meeting, Prince Edward Hotel, Montreal, Canada, Oct. 14 to 16. M. L. Heminway, general manager, 250 West 57th St., New York.

National Industrial Advertisers' Association. Annual meeting, Chalfonte-Haddon Hall Hotel, Atlantic City, N. J., Oct. 19 to 21. W. A. Wolff, chairman, the Western Electric Co., 195 Broadway, New York.

Management Week. Conducted jointly by five societies—The American Society of Mechanical Engineers, The American Management Association, The National Association of Cost Accountants, The Taylor Society and the Society of Industrial Engineers. Week of Oct. 19 to 24. W. L. Conrad, of the A. S. M. E., is chairman of the joint committee.

American Welding Society. Exposition of welding equipment and accessories, Massachusetts Institute of Technology, Cambridge, Mass., Oct. 21, 22 and 23. R. L. Browne, chairman, 141 Milk St., Boston, Mass.

American Society of Mechanical Engineers. Annual meeting, Engineering Societies Bldg., 29 West 39th St., New York City, Nov. 30. to Dec. 3. Calvin Rice, secretary, Engineering Societies Bldg., New York.

National Exposition of Power and Mechanical Engineering. Fourth annual event, Grand Central Palace, New York City, Nov. 30 to Dec. 5. Charles F. Roth, manager, International Exposition Co., Grand Central Palace, New York City.

American Association for the Advancement of Science. Annual meeting, Kansas City, Mo., Dec. 28, 1925, to Jan. 2, 1926. Barton E. Livingston, secretary, Smithsonian Institute Bldg., Washington, D. C.

The Weekly Price Guide

Rise and Fall of the Market

Iron and Steel—Price of iron is tending upward; demand steady; No. 2 f'dry So., up 50c. per ton during week; reserve stocks diminishing. Although the principal hot-rolled steel products are at about the same prices as a week ago, there is still some cutting under in plates. Sheets are also weak. Steel bars, tin plates and wire products are firm and moving in fairly good volume.

Non-Ferrous Materials—Copper inquiry better. Both copper and lead selling at the same price as a week ago in New York warehouses. Zinc ¼c. and tin 1¼c. per lb. above level of Sept. 25. Coke, prompt foundry, up 25@50c. per ton at Connellsville.

(All prices as of Oct. 2)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$23.05
Northern Basic	22.27
Southern Ohio No. 2	22.77
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	27.37
BIRMINGHAM	
No. 2 Foundry	19.50
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	22.26
Virginia No. 2	29.17
Basic	21.16
Grey Forge	.....
CHICAGO	
No. 2 Foundry local	22.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	25.55
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	20.77
Basic	20.77
Bessemer	20.77

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	5.00@5.50
Cleveland	4.90@5.00
Cincinnati	5.00@7.50
New York	5.00@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.25@2.30	3.89	3.00	3.50
No. 12	2.30@2.35	3.94	3.05	3.55
No. 14	2.35@2.40	3.99	3.10	3.60
No. 16	2.45@2.50	4.09	3.20	3.70
Black				
Nos. 17 to 21	2.90@3.00	4.15	3.60	3.80
Nos. 22 to 24	2.95@3.05	4.20	3.65	3.85
Nos. 25 and 26	3.00@3.10	4.25	3.70	3.90
No. 28	3.10@3.20	4.35	3.80	4.00
Galvanized				
Nos. 10 and 11	3.20@3.30	4.35	4.00	4.00
Nos. 12 to 14	3.30@3.40	4.45	4.10	4.10
No. 16	3.45@3.55	4.60	4.25	....
Nos. 17 to 21	3.60@3.70	4.75	4.40	4.40
Nos. 22 to 24	3.75@3.85	4.90	4.55	4.55
No. 26	3.90@4.00	5.05	4.70	4.70
No. 28	4.20@4.30	5.35	4.95	5.00

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	54%	41%
3½ to 6 in. steel lap welded	48%	35%	53½%	40½%	51%	38%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameters Inches External	Diameters Inches Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following base discounts are on 20 gauge or .035-in., round, cold-drawn tubing, ⅛-in. to 1-in., O.D., weighing 0.17 lb. to 0.36 lb. per ft. Cutting charge per 100 cuts, $1.50 to $1.58:

O.D. Inches	List Price per ft.	Differential Discount	O.D. Inches	List Price per ft.	Differential Discount
⅛	$0.15	50%	⅞	$0.18	35%
¼	.16	45%	1	.19	31%
⅜	.17	40%			

NOTE—The discounts are to be lowered by the following differentials in the case of regular .10-.30 carbon: 25,000 ft. or over, 83; 15,000 to 25,000 ft., 82; 5,000 to 15,000 ft., 81; 1,000 to 5,000 ft., 80; less than 1,000 ft., 79.

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Open hearth spring steel (base)	4.00	....	4.00@4.65
Spring steel (light) (base)	7.00	6.00	6.00
Coppered Bessemer rods (base)	6.05	....	....
Hoop steel	4.49	3.85	4.15
Cold rolled strip steel	6.35	8.25	6.80
Floor plates	5.55	5.60	5.50
Cold drawn shafting or screw	4.15	3.80	3.60
Cold drawn flats, squares	4.65	4.30	4.10
Structural shapes (base)	3.34	3.20	3.10
Soft steel bars (base)	3.24	3.10	3.00
Soft steel bar shapes (base)	3.24	3.11	3.10
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.40	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	60%	55%	60%

Electric welding wire, New York, 3/32, 8.25c.; ⅛, 7.85c.; 5/32 to ½, 7.35c. per lb.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			15.00
Tin, 5-ton lots, New York			61.50
Lead (up to carlots) E. St. Louis	9.25	New York	10.25
Zinc (up to carlots) E. St. Louis	7.90	New York	8.87½

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	18.00	20.00	....
Copper sheets, base	22.75	22.75	22.75
Copper wire, base	20.25	17.00	16.75@17.00
Copper bars, base	21.87½	21.50	21.87½
Copper tubing, base	24.75	25.50	24.75
Brass sheets, base	19.12½	19.00	19.12
Brass tubing, base	23.75	23.75	23.75½
Brass rods, base	16.87½	16.87½	16.87
Brass wire, base	19.62½	22.50	19.62½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1-15 ton lots	28.00	28.00	28 03
Zinc sheets (casks)	11.25	12.00	11 52
Solder (½ and ½), (case lots)	39.50	39 00	38@42
Babbitt metal (83% tin)	60.00	68 75	58@63
Babbitt metal (35% tin)	28.00	22.50	30@35
Nickel (ingots) f.o.b. refinery	31.00	.....	.....
Nickel (electrolytic) f.o.b. refinery	38.00	.....	.....
Nickel (shot) f.o.b. refinery	32.00	.....	.....

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00
Manganese nickel hot rolled rods "E"—low manganese (base)	54.00
Manganese nickel hot rolled rods "D"—high manganese (base)	57.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00
		Cold rolled sheets (base)	50 00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	12.50@12.75	11.75	11.75@12.25
Copper, heavy, and wire	12.00@12.25	11.50	11.00@11.50
Copper, light, and bottoms	10.00@10.25	9.75	10.00@10.75
Heavy lead	7.75@ 8.25	7.50	7.75@ 8.25
Tea lead	6.50@ 7.00	4.50	6.25@ 6.75
Brass, heavy, yellow	7.25@ 7.50	7.25	7.50@ 8.00
Brass, heavy, red	9.50@10.00	9.75	8.50@ 9.00
Brass, light	6.25@ 6.50	6.00	7.00@ 7.50
No. 1 yellow rod turnings	8.25@ 8.50	8.00	7.50@ 8.00
Zinc	4.75@ 5.25	4.00	4.25@ 4.75

TIN PLATES—American Charcoal—Bright—Per box.

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$11.25	$11.45	$11.50
"A" Grade:				
IC,	14x20	8.85	9.40	9 50
	Coke Plates—Primes.			
100-lb.,	14x20	6.50	6.10	7.00
	Terne Plates—Small lots. 8-lb. Coating			
IC,	14x20	7.25	6.95	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.15@0.22	$0.19	$0 20
Cotton waste, colored, per lb.	.10@ .15½	.18	.17
Wiping cloths, washed white, per lb	.17	36.00 per M	.15½
Sal soda, per 100 lb. keg	2.25	2.25	2.75
Roll sulphur, per 100 lb. keg	3.75	3.75	4.50
Linseed oil, per gal., 5 bbl. lots	1.04½	1.15	1 03
Lard cutting oil, 25% lard, per gal.	.55	.50	.72
Machine lubricant, medium-bodied (50 gal. wooden bbl.), per gal.	.35	.35	.26
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40%	40%	30–10%
Heavy grade	30–10%	35%	30–5%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50–5%	50–10%	50%
Second grade	50–10–5%	60–5%	50–10%

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.0415	.0415	.0405
Brass rods	per lb	.1687½	.1687½	.1462½
Solder (½ and ½)	per lb.	.395	.395	.37@.38
Cotton waste	per lb.	.15@.22	.15@.22	14@21
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	6.50
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.55	3.55	3.38
Lard cutting oil	per gal.	.55	.55	.55
Machine oil	per gal.	.35	.35	.29
Belting, leather, medium	off list	40%	40%	40–2½%
Machine bolts up to 1x30 in.	off list	40%	40%	50%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.46	$5.84	$5.00
Emery paper	10.71	11.00	11.90
Emery cloth	29 48	31.12	32.75
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.41	1.40
Cloth	3.55	2.67	3 55
Fire clay, per 100 lb. bag		.60	.75
Coke, prompt furnace, Connellsville	per net ton		3.50@4.00
Coke, prompt foundry, Connellsville	per net ton		4.75@5.25
White lead, dry or in oil	100 lb. kegs	New York, 15.75	
Red lead, dry	100 lb. kegs	New York, 15.75	
Red lead, in oil	100 lb. kegs	New York, 17.25	

SHOP SUPPLIES

Machine bolts, ¾x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1¼ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%. Machine bolts, up to 1x30-in., with cold punched and hot-pressed hex. nuts, also button head bolts with hex. nuts are $3.60@3.75 per 100 lb. at Cleveland.

Carriage bolts, ¾x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{5}{16}$-in., $2.25 per 100, less 40%.

Tap bolts, 1½x½-in., $1.00 per 100. List plus 35% at New York warehouses; with hex. heads, $4.65 per 100 lb. net at Chicago.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ½x½-in., 2c. each. Discount 70% for $\frac{5}{16}$-in. and smaller and 65% for ⅜-in. and larger.
Case hardened ½x½-in., 6c. each, less 50%.

Rivets, button heads, ⅜-in., ½-in., 1-in. diam. x2$\frac{1}{16}$-in. to 4½-in., $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, $\frac{1}{16}$x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1¼ to 2-in. long, all diameters, 25c.; ⅜-in. dia., 35c.; ½-in. dia., 75c.; 1-in. long and shorter, 75c., longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk heads, 45c.

Washers, cast iron, ½-in., $7.00* per 100 lb. at New York warehouses; ⅜-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Ark., Fort Smith—The C. R. Hays Chair & Table Co., 413 North 24th St., E. H. McCulloh, Secy.—machinery for plant to increase capacity. Estimated cost $40,000.

Ind., Anderson—Remy Electric Co., Columbus Ave.—equipment for manufacture of generators, etc.

Mass., Boston—Gerard Electric Co., 92 Pearl St., 6 ft. engine lathe.

Mich., Detroit—A. N. Haskell, 414 East Woodbridge St. machinery — shapers (used.)

N. Y., Brooklyn—Long Island Machine Works, 69 Adams St.—No. 3 Becker vertical miller.

N. Y., Brooklyn—A. Riley, 260 Hayward St.—pipe threader up to 2 in.

N. Y., New York—G. Padula, 307 Mott St.—small Brown & Sharpe surface grinder.

N. Y., Orlean—Clark Bros. Co.—5 ton overhead electric crane.

O., Canton—Rogers Motor Sales Co., J. H. Rogers, Genl. Mgr.—Special equipment for sales and service station.

O., Kent — Kent Sheet Metal & Rfg. Works, 233 North Rivers St.—8 to 10 ft. gutter forming machine.

O., Louisville—Hiner Structural Steel Co., Canton Bldg., Canton, G. C. Hiner, Purch. Agt.—boring and grinding machines, lathes, drill presses, etc., for new plant here.

Pa., Rochester — Pittsburgh Grinding Wheel Co.—hydraulic press 600 to 1,000 ton pressure.

Va., Richmond—Chesapeake & Ohio Railroad, 825 East Main St., R. M. Nelson, Purch. Agt.—25 ton locomotive crane.

Wis., Milwaukee—Central Board of Purchases—lathe, motor driven crank shaper, and universal miller.

Wis., Milwaukee—Seamless Steel Products Co., 27th and Canal Sts.—welding equipment.

Wis., Sheboygan—Jenkins Machine Co., 301 North 8th St., A. G. Stuedemann, Pres. traveling crane.

Que., Montreal—Z. Charlonneau, 63 Guizot St.—small band saw and planer.

Que., Montreal—J. Gariepy, 550 De Lauadiere St.—mortiser machine and iron saw bench.

Que., Montreal — J. H. Gauthier, 712 Demontigny St.—lathe, air compressor, etc.

Que., Montreal—Guimond Bros., 37 De la Roche St.—machinery for cooperage shop.

Que., Montreal—J. Lacroit, 18 St. Henry St.—36 in. band saw and joiner for pattern shop.

Que., Montreal—J. Legace, 44 Montcalm St.—planer and band saw.

Que., Montreal—H. Marois, 401A St. Zotique St. E.—lathe and a boring mill.

Que., Montreal—N. Pariseau, 2666 27th Ave.—planer and blower.

Que., Montreal—L. Poirier, 3174 Marron St.—complete equipment for blacksmith shop.

Opportunities for Future Business

Calif., Oakland — The California Steel Products Co., 452 Bay St., San Francisco, has purchased 4½ acres of land and plans the construction of a plant for the manufacture of refrigerating equipment, pipes and boilers, at 66th and 68th Aves., here.

Ill., Chicago—Central Chicago Garage, Inc., 208 South La Salle St., awarded contract for the construction of a 10 story, 99 x 150 ft. garage at State and Kinzie Sts. Estimated cost $400,000.

Ind., Anderson—Remy Electric Co., Columbus Ave., will build 200 x 520 ft. plant for the manufacture of generators, etc., with own forces. Estimated cost $90,000. N. R. Kettering, Anderson, engr.

Ind., Indianapolis—Ira Holmes, American Central Life Bldg., plans the construction of a 2 story garage on Alabama St. Estimated cost $300,000. Private plans.

Ind., Kokomo—The Kokomo Brass Co., awarded contract for the construction of a 50 x 132 ft. addition to plant. Estimated cost $37,000.

La., New Orleans—O. F. Briede, Jr., 416 Girod St., awarded contract for the construction of a 3 story car manufacturing plant. Estimated cost $50,000.

Mass., Dorchester (Boston P. O.) — Thompson Wire Co., 41 Mildred Ave., is receiving bids for the construction of a 1 story factory. Estimated cost $40,000. Brainard & Leeds, 89 Franklin St., Boston, Archts. Noted Oct. 1.

Mass., Fall River—Webb Oil Co., 8 Durfee St., is having plans prepared for the construction of a 2 story, 120 x 140 ft. garage. Estimated cost $165,000. N. Chase, 167 Bedford St., Archt.

Mass., Milford—Milford Electric Light & Power Co., 241 Main St., is having plans prepared for the construction of a 2 story addition to plant. Estimated cost $40,000. E. L. Rawson, 6 Beacon St., Boston, Archt.

Mass., New Bedford—R. W. Powers, 501 County St., awarded contract for the construction of a 1 story repair and service garage and show room. Estimated cost $45,000.

Mass., Newburyport—Towle Mfg. Co., 260 Merrimac St., is receiving bids for the construction of a 3 story, 32 x 100 ft. factory for the manufacture of table silverware. Estimated cost $40,000. G. Perkins, 200 Devonshire St., Boston, is engineer.

Mass., Somerville (Boston P. O.)—Ford Motor Co., E. Ford, Pres., Highland Park, Mich., awarded contract for the construction of a 1 story, 301 x 1130 ft. assembling plant on Middlesex Ave. here. Estimated cost $4,000,000. Noted Sept. 10.

Mich., Detroit—Public Lighting Comn., East Atwater St., awarded contract for the construction of the superstructure for power plant including machine shop, etc., on Morrell St. $1,534,800. Noted Sept. 24.

Minn., Minneapolis—Minneapolis Society for the Blind, 630 Marquette Ave., awarded contract for the construction of a 2 story broom and brush plant, basket and cane shops, etc., at 2835 Nicollet Ave. Estimated cost $40,000.

Minn., St. Paul—H. E. Pence, 800 Hennepin Ave., Minneapolis, awarded contract for the construction of a 2 story, 150 x 160 ft. garage at 6th and Exchange Sts., here. Estimated cost $250,000.

Miss., Meridian — American Creosote Works, Southport, New Orleans, La., S. C. Braselman, Gen. Mgr., is having preliminary plans prepared for the construction of a creosoting plant here. Private plans.

Mo., Kansas City—E. Saulsbury, 3526 Broadway, plans the construction of a garage. Estimated cost $150,000.

Mo., St. Louis—Killark Electric Mfg. Co., 3940 Easton Ave., soon takes bids for 1 story, 140 x 200 ft. plant for manufacture of electric equipment, on Easton Ave. Estimated cost $60,000. Private plans.

Mo., St. Louis—Terminal R.R. Association, c/o Union Station, will build 2 story, 20 x 500 ft. service station, on Scott Ave., with own forces. Estimated cost $45,000.

N. Y., New York—New York Transfer Co., 263 5th Ave., awarded contract for the construction of a 4 story, 100 x 150 ft. garage at 603 West 42nd St. Estimated cost $500,000.

O., Canton—Canton Auto Spring Co., 117 13th St., S. E., plans the construction of 1 story factory addition, at 13th and Factory Sts. Estimated cost $45,000.

O., Canton—Rogers Motor Sales Co., J. H. Rogers, Genl. Mgr., is having plans prepared for the construction of a 2 story, 50 x 205 ft. sales and service station, here. Estimated cost $100,000. Company engineers in charge.

O., Cleveland—Cleveland Metal Stamping Co., F. W. Judd, Pres., 5303 Hamilton Ave., has had plans prepared for the construction of a 2 story, factory at 331 St. and Payne Ave. Estimated cost $40,000. G. S. Rider & Co., Century Bldg., Archts.

O., Cleveland—Cleveland Range Co., F. A. Hensinger, Secy., 519 Huron Road, plans the construction of a factory. Estimated cost $40,000. Architect not selected.

O., Cleveland—Green Cab Co., c/o A. Waite, 1618 Walnut Ave., has had plans prepared for the construction of a 3 story, 40 x 120 ft. garage on Oregon Ave. Estimated cost $200,000. Ohio Engineering Co., Seidman Bldg., Archt. and Engr.

O., Louisville—Hiner Structural Steel Co., Canton Bldg., Canton, plans 60 x 150 ft. mill addition for plant, here. Estimated cost $50,000.

Pa., Philadelphia — Atwater Kent Co., awarded contract for the construction of a 1 story, 119 x 225 ft. addition to radio manufacturing plant at Roberts Ave. and King St. Noted Sept. 24.

Pa., Philadelphia—Jacob Bloom Co., 1049 Frankford Ave., will soon award contract for the construction of a 4 story, 30 x 100 and 20 x 50 ft. addition to factory on Frankford Ave. and Wildey St., for the manufacture of cedar chests. Estimated cost $40,000. W. Lowenthal, 1208 Chestnut St., Archt.

Pa., Philadelphia—Heintz Mfg. Co., Front & Olney Sts., awarded contract for the construction of a 3 story, 70 x 200 ft. addition to plant for the manufacture of auto supplies.

Wis., De Pere—Hudson Mfg. Co., Main St., plans the construction of a 2 story factory for the manufacutre of barn equipment to replace fire loss. Estimated cost $40,000. Architect not selected.

Wis., Kohler—Kohler Co., manufacturers of plumbing fixtures, is receiving bids for the foundation for a 5 story, 82 x 200 ft. factory. Private plans. A. Treick, will supervise construction.

Wis., Marshfield—L. F. Diddle, is having plans prepared for the construction of a 2 story, 50 x 82 ft. factory for the manufacture of lightning rods. Estimated cost $40,000. F. Felhofer, Archt.

Wis., Milwaukee—Seamless Steel Products Co., 27th and Canal Sts., awarded contract for the construction of a 1 story, 52 x 90 ft. addition to factory. Estimated cost $30,000.

Wis., Oshkosh—J. W. Hewitt Machine Co., 131 North Commercial St., awarded contract for the construction of a 1 story, 40 x 70 ft. addition to machine shop.

Wis., Oshkosh—Universal Foundry Co., Pine and Warren Sts., awarded contract for the construction of a 2 story, 40 x 80 ft. pattern shop.